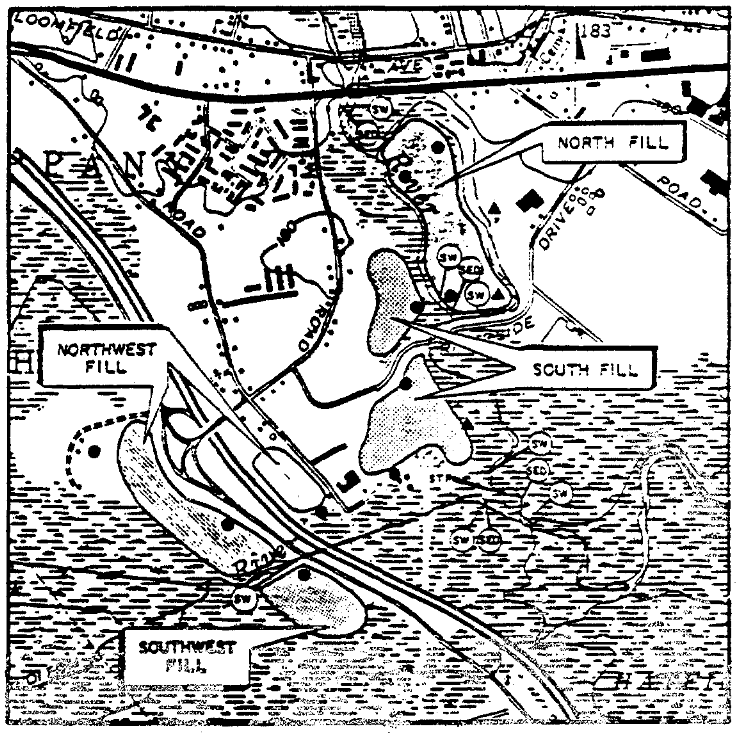
TASK 3 - SITE INVESTIGATIONS
(REMEDIAL INVESTIGATION REPORT - VOL. I)

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
SHARKEY FARMS LANDFILL SITE

Parsippany - Troy Hills Townships
Morris County, New Jersey

53761



Submitted to:

NEW JERSEY

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Hazardous Site Mitigation Administration

JULY 1986

By:

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Middletown, PA.

HydroQual, Inc.
Mahwah, N.J.

SHA 001 0904

TASK 3
SITE INVESTIGATIONS
(VOLUME I)

FOR

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
SHARKEY FARMS LANDFILL SITE
PARSIPPANY AND TROY HILLS TOWNSHIPS
MORRIS COUNTY, NEW JERSEY

SUBMITTED TO:

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
HAZARDOUS SITE MITIGATION ADMINISTRATION

JULY 1986 - FINAL REPORT

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EXECUTIVE SUMMARY

This report presents the results of Task 3 - SITE INVESTIGATIONS - for the Sharkey Farms Landfill Remedial Investigation and Feasibility Study (RI/FS) as required in the Request for Proposal and outlined in ACCE/H&S Proposal (X-373) of April 1984. The RI/FS was undertaken under the direction of the New Jersey Department of Environmental Protection (NJDEP) in September 1984. Prior to this submittal, Tasks 1, 2 and 3A were completed, and reports were submitted to NJDEP. These Task Reports were:

- ° Task 1 - Initial Site Investigation and Site Security
- ° Task 2 - Preinvestigation Activities (Required Plans)
- ° Task 3A - Compilation of Background Information on the Sharkey Site.

This Task 3 report is the Remedial Investigation (RI) Report for the Sharkey Landfill Study and presents the results of the field investigation which included an extensive review of site characteristics, geology, groundwater quality, and surface water quality.

Since there was very limited information available on waste sources suspected dumped at the site and its impact on the surrounding environment, the Remedial Investigation was conducted at the Sharkey Site between July and December 1985 to collect chemical and physical information on the site characteristics and its potential impact on the environment and public. The purpose of the study was to define the level and extent of the contamination at the site and to develop the information needed to evaluate appropriate remedial alternatives.

The Remedial Investigation Report is divided into two (2) Volumes. Volume 1 of this report presents the results of the RI study and is divided into six (6) Chapters:

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- Chapter 1 - Introduction - includes a description of the Site highlighting historical information on the Site, discusses the basis of the RI/FS, and outlines the contents of this report.
- Chapter 2 - Air Investigation - summarizes the existing data on air quality for the Sharkey Site.
- Chapter 3 - Subsurface Investigation - presents the extensive study results for the field investigation on geology, groundwater, hydrogeology and soils. This Chapter was prepared by R. E. Wright Associates, Inc. (REWAI), the hydrogeological consultants, who conducted these studies and analyzed the field data.
- Chapter 4 - Surface Water Investigation - presents the results of the detailed water quality surveys which included sampling surface waters, sediments and leachates during two periods, dry weather and wet weather conditions. This Chapter was prepared by Hydroqual Inc. (HQI), water quality consultants, who carried out the field surveys and analyzed the survey data.
- Chapter 5 - Summary of Field Investigation Results - highlights the results of the chemical analysis on samples collected on the surface waters, sediments, leachates, groundwater, potable wells, and soils.
- Chapter 6 - Proposal Response - discusses the analysis of off-site and on-site environmental and public health concerns based on the results of the field investigation. This analysis served as the basis for developing remedial action objectives.

Volume II contains the Appendices which are the field data and calculations associated primarily with the hydrogeological investigation (Chapter 3).

BACKGROUND INFORMATION

The Sharkey Farm Landfill Site is approximately 90 acres and is located in the Townships of Parsippany-Troy Hills and East Hanover, Morris County, New Jersey. Because of its irregularly shaped and disconnected areas, the Site is divided into five major areas; North Fill, South Fill, Southwest Fill, Northwest Fill

(North of 280), and Northwest Fill (South of 280). The Site is bounded by Route 46 to the north, New Road to the west, and the Rockaway River to the east. To the south, sections of the site extend beyond Route 280 into the neck between Troy Meadows and the Hatfield Swamps. The general area in which the landfill is located can be described as residential and light industrial to the north and west with the Whippany River, and considerable swampland to the east and south. Approximately, eight (8) miles downstream, the Passaic River is used as a source of drinking water by the Passaic Valley Water Commission. The Site was closed in 1972, but in a 7-year period between 1962 and 1969, it had been reported that the landfill accepted industrial wastes. There is very limited information on the amount of industrial waste dumped at the site, where it was dumped, or by whom.

REMEDIAL INVESTIGATION RESULTS

The major field investigations for Task 3 included: two water quality surveys including leachate and sediment sampling; the construction of 26 monitoring wells and sampling of the shallow and lower aquifers; air sampling; soil sampling; and sampling of residential and commercial wells. The following summarizes the results of the field investigation.

Air Investigation

Limited air monitoring has been reported. The only sources of air quality data were the RAMP (1983), DEP monitoring of August 22, 1983, a 24 hour air monitoring investigation during the initial site visit for the RI Study (September 1984), and monitoring taken by field crews during the construction of the monitoring wells. The results indicated that the air quality measurements, including the 24 hour study in 1984, suggest low probability of respiratory or dermal hazards from air-borne volatile organics under ambient conditions.

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Subsurface Investigation

Twenty-six (26) monitoring wells were constructed at the Sharkey Site to investigate the hydrology, geology, and chemistry of the area and groundwater. Fourteen groundwater wells were constructed in the shallow aquifer, 10 wells in the lower aquifer as intermediate wells and two wells on the lower aquifer as deep wells. The shallow water table aquifer is separated from the lower aquifer by a silty clay unit. The clay unit is between 15 and 40 feet thick, possesses a low permeability, and appears to provide significant hydraulic isolation between the shallow aquifer and the lower unconsolidated aquifer.

Each of the 26 monitoring wells were sampled in November 1985 to characterize the chemistry beneath the site and in nearby wells. The details of this investigation is presented in Chapter 3 of this Report. The following summarizes the conclusions and recommendations of the subsurface investigation which are presented in Chapter 3.

Physical Characterization of the Site

1. On the basis of information obtained from the completion of the monitoring wells, five distinct saturated deposits (strata) were identified beneath the study area. These include fill, upper alluvial deposits, gray varved clay, lower glacial outwash deposits, and bedrock.

2. Constant head permeability tests on the varved clay unit indicated that the unit has an average permeability of approximately 1.3×10^{-7} cm/sec.

3. The combination of geophysical logs, monitoring well drilling logs, and logs from previous foundation borings confirm the existence of a continuous, mapable, low permeability varved clay unit beneath the site. This unit separates the upper alluvial deposits from the lower glacial outwash deposits.

   A depression or trough has been delineated in the upper surface of the clay unit beneath the central portion of the Parsippany-Troy Hills Sewage Treatment Plant (STP).

4. It is possible that contaminant flow in the upper (shallow) aquifer traversing the North or South Fill area, especially

any contaminants of density greater than water, could become entrapped within this depression.

5. Fill thicknesses on the North Fill vary from approximately 85 feet at the south end to about 45 feet at the north. On the South Fill, maximum fill thicknesses range from approximately 80 feet to the west of the Parsippany-Troy Hills STP to 65 feet on the northern perimeter of the STP.

6. The gray varved clay unit was apparently encountered during landfilling operations on both the North and South Fill areas. There is no evidence that complete penetration of the clay unit has occurred.

7. A shallow water table aquifer is present, separated from the lower confined aquifer by the gray varved clay unit. The shallow aquifer is present within the upper alluvial deposits and fill material. The lower aquifer occupies the lower glacial outwash materials between the varved clay deposit and bedrock.

8. Water level monitoring of the shallow aquifer has indicated that groundwater mounding is evident on the North Fill within topographically pronounced fill deposits. The lagoon near the southeastern corner of the STP appears to have caused mounding of the shallow aquifer water table due to infiltration of process water.

9. Shallow aquifer flow patterns indicate that the flow direction in this aquifer is generally toward the Rockaway and Whippany Rivers.

10. The water level data obtained from the lower aquifer suggests that the flow system for this aquifer is not in unison with the upper shallow aquifer in terms of flow direction. The flow pattern in the lower aquifer appears to diverge to the northwest and southeast form the vicinity of the sewage treatment plant. Even minor localized fluctuation of the water levels observed in the lower aquifer could significantly alter the interpretation of the groundwater flow directions in the lower aquifer.

11. Calculated aquifer storage coefficients suggests that the lower aquifer is a confined flow system with low potential for vertical flow.

12. The annualized rate of groundwater discharge from the North Fill within the shallow aquifer to the Rockaway River is 51,750 gallons per day (gpd).

13. The annualized rate of groundwater discharge from the South Fill, Northwest fill, Southwest Fill and STP lagoon infiltration to the Whippany and Rockaway rivers within the shallow aquifer is 205,000 gpd.

14. Leakage form the shallow aquifer to the lower aquifer is negligible, estimated at an annualized rate of only 100 gpd.

Chemical characterization of the Site

1. There were no semi-volatile compounds detected in groundwater samples at levels exceeding the EPA Proposed Maximum Contaminant Levels of the NJDEP Interim Action levels for drinking water supplies.

2. Two volatile organic compounds were found at concentrations exceeding the EPA Proposed Maximum Contaminant Levels and the NJDEP Interim Action Levels for drinking water supplies. They were benzene and trichloroethylene (TCE). Benzene was found in five shallow wells on the site; two on the North Fill, two on the South Fill, and one on the Northwest Fill. TCE also occurred in the well on the Northwest Fill.

   The only intermediate-series well (lower aquifer) which exceeded these drinking water standards (for the compound benzene) was Well WI-17.

3. Most significant, in terms of inorganic contamination on site were the detection of cadmium, chromium, cyanide, lead and nickel. High levels of iron and manganese appeared to be common throughout the area.

4. The detection of cyanide remains questionable due to the detection of the compound in a field blank. The low level detection of cyanide in the public water supply Well (Homestead Avenue well) in East Hanover Township should be reassessed.

5. Although the presence of cadmium, lead and nickel were generally above drinking water standards in the landfill, there does not appear to be an adverse effect on the Rockaway or Whippany Rivers downstream.

6. Although organic contamination has been detected in each fill area, the levels of contamination do not appear to result in adverse effects on the quality of the adjacent Rockaway and Whippany Rivers.

7. There are no known drinking water sources or private wells within the area immediately downgradient from the landfill in the shallow aquifer. Therefore, the contamination noted does not appear to pose an immediate threat, under present water level distribution and pumping conditions.

8. Phenol levels are all below the NJPDES drinking water standard of 3500 ug/l. However, it was detected at many locations throughout the area, including the potable water supply wells. In view of fluctuation criteria for this contaminant, resampling of potential or drinking water sources in the area would be advisable to confirm the presence of the contaminant.

9. Seven organic compounds were identified in the soil samples. These include acetone, 2-butanone, napthalene, phenanthrene, 2-methylnapthalene, fluoranthene, and pyrene. Only acetone and napthalene were also found in groundwater samples. However, there is no apparent direct correlation between locations of such soil and groundwater contamination.

10. Five anamalous electromagnetic conductivity areas were delineated during the electromagnetic survey. Subsequent magnetometer surveys of these five areas indicated that four of these anamalies were probably caused by buried iron mass. The soils from the remaining electromagnetic anomaly site were subsequently sampled and submitted for chemical analysis. No significant detection of organic compounds was reported.

Recommendations

1. Adequate landfill cover, propagation of vegetative growth in abandoned landfill areas, and stabilization of landfill banks in the vicinity of the river channels should be given priority consideration in the selection of remedial alternatives.

2. Wells that revealed positive detections of cyanide should be resampled, particularly the East Hanover Township Homestead Avenue well.

3. Well WI-17 should be sampled and tested to confirm the presence of benzene and/or organic contaminants.

4. At least one well should be constructed in the central portion of the Parsippany-Troy Hills sewage treatment plant to explore the deepest area of the shallow aquifer in that vicinity. This well should be screened immediately above the varved clay unit. A water sample should be obtained from this well and analyzed for priority pollutants.

5. At least two additional wells should be constructed on the east side of the Rockaway River in Montville Township. These wells should be located in the marshy area to the south of the North Fill and to the northeast of the South Fill. The purpose of these wells is to further delineate the topography of the top of the clay unit. These wells should be screened at the top of the clay unit and groundwater samples obtained for chemical analyses. The purpose of the analyses is to assess the potential for heavier than water contaminants migrating along the surface of this unit, eluding direct Rockaway river flow channel capture.

   Due to the difficult access conditions in this area, selection of well construction sites cannot be determined until after field inspection.

Surface Water Investigation

Two surface water and leachate sampling surveys were conducted at the Sharkey Landfill site. The first, the dry weather survey, was conducted July 23 and 24, 1985, and included sediment sampling. The second, the wet weather survey, was conducted November 5, 1985, following and during a significant rainfall event in the area. The purpose of the investigation was to determine if contaminants were being released from the landfill to surface waters during dry and wet weather conditions. Chapter 4 of this Report discusses the water quality surveys. The following is a summary of the water quality study results which are presented in Chapter 4.

Surface Water Results

There was no significant contamination of the surface waters at the Sharkey Landfill Site by organic or inorganic priority pollutants. Surface waters downstream of the site met various water quality standards and aquatic toxicity criteria.

A comparison was made of upstream and downstream water quality parameters measured, in both the dry and wet weather surveys and sediment data from the dry weather survey. The organic data indicate very low concentrations of total organics, and essentially no obvious or significant (two sets of data) differences in upstream and downstream water column concentrations, except possibly for phenol and maybe cyanide results in the wet weather survey. These levels of contamination, however, would not be considered significant based on a comparison with different water quality criteria and standards.

Sediment Analysis

Sediment samples taken during the dry weather survey contained relatively low levels of volatile organics. Estimated values of unknown volatile organics were relatively low and did not indicate significant pollution in the river sediments through the region of the site.

The upstream sample on the Rockaway River contained a higher level of acid base neutral (ABN) priority pollutants than the downstream samples of which were zero. The Whippany River sediment, downstream of the site, contained 2040 ug/l ABN priority pollutants.

Upstream sediment samples contained 31,499 and 2661 ug/kg of unknown ABNs in the Rockaway and Whippany Rivers, respectively. Downstream levels in the Rockaway were 13,766 and 29,323 ug/l above and below the confluence with the Whippany River.

Of the priority pollutant metals detected in the sediments, none, except possibly zinc and copper in the Whippany, increased to any significant extent from upstream to downstream samples.

The presence of the unknown ABNs in the sediments was not considered significant evidence of contamination of the surface waters due to the site. The low levels of contaminants in the water column which did not include most of those unknown ABNs found in the sediment were considered more indicative of pollutant loads form the site. Various reasons for the levels of ABNs seen in the sediment might be proposed and could include transport from upstream locations either as sediment or in the water column, long term gradual transfer form the water to the sediments, or possibly due to a past spill or discharge to the streams.

Quality Assurance/Quality Control (QA/QC) Review

There were some analytical QA/QC problems with various metals analyses, and these are discussed in Chapter 4 in the QA reviews. In general, the acceptable data did not indicate any significant contribution to surface waters from the site. The data, considered unacceptable due to various quality control limitations, did not indicate any significant or potential contaminant concentration concerns which warranted further sampling or investigations during the study.

REMEDIAL OBJECTIVES

The results of the field investigations indicated that the Sharkey Landfill has a limited degree of contamination in that the number of hazardous compounds present is small and at very low concentrations, and the materials are localized primarily at this time to the shallow aquifer on the Site. Since there are presently very limited environmental or public health problems relative to the surface waters, sediments, leachates, air and soil because of the low level of contamination monitored at this Site, the primary remedial objective would be to minimize the potential for migration of the low level of groundwater contamination monitored in the shallow aquifer to the surface waters which are used downstream for drinking water after treatment. In addition to this primary objective, there are several other remedial objectives that must be considered in the analysis of appropriate remedial alternatives:

° Long term monitoring should be considered to evaluate air quality, and surface and ground water characteristics on a regular basis.

° Additional site security should be considered to control public access to the site.

° Erosion control for the banks of the Rockaway River should be included in the alternatives analysis to minimize the loss of refuse to the Rockaway River downstream of the Site.

° Also, additional monitoring should be considered for intermediate well, WI-17, to check out if the lower aquifer is contaminated with benzene as indicated in the November 1985 survey.

° Also, monitoring of the Homestead public well in East Hanover should be considered to check out the cyanide level found in the November 1985 sampling.

° The monitoring of phenol at many surface water stations during the wet weather survey suggests that phenol monitoring be considered in future monitoring of the Rivers.

° Since there were some interferences in the laboratory analysis of several metals (e.g., nickel, chromium, iron, manganese) during both survey periods, and additional sampling survey should be considered for all surface water, groundwater, leachate, soils, and potable well sampling sites.

1. INTRODUCTION

This Chapter presents an overview of the Site. It includes a description of the Site and discusses historical data and the basis for the Remedial Investigation Study. This Chapter also presents a chronology of the field investigation and outlines the information presented in the other Chapters of this RI Report.

SITE BACKGROUND INFORMATION

The information presented in this subsection is a general characterization of the Site based on the 1983 Remedial Action Master Plan (RAMP) prepared by NUS Corporation; initial site investigations; review of DEP Files; and observations during the field investigation.

Site Location and Description

The Sharkey Farm Landfill Site is located in the Townships of Parsippany-Troy Hills and East Hanover, Morris County, New Jersey. Exhibit 3-1 is a site map of the study area which lies within the area bounded by Route 46 to the north, New Road to the west, and the Rockaway River to the east. To the south, sections of the site extend beyond Route 280 into the neck between Troy Meadows and the Hatfield Swamp. The general area in which the landfill is located can be described as residential and light industrial to the north and west, and considerable swampland to the east and south. The average temperature is 53.8°F and the average precipitation is 42 inches annually.

The site is located approximately 1/2 mile southwest of the Pine Brook section of the Township of Montville, and is centered approximately at 40°50'50" north latitude and 74°20'50" west longitude. The landfill site consists of approximately 90 acres of irregularly-shaped, disconnected areas. The site has been divided into the following five (5) areas (see Exhibit 3-1):

° North Fill. This area is located at the northern end of Sharkey Road, and is bounded by branches of the Rockaway River. The North Fill Bridge over the west branch provides limited access to the 26 acre island. The island is owned by the Township of Parsippany-Troy Hills.

This island site in the Rockaway River is approximately 26 acres in size and contains fill with intermittent soil cover to a depth of 80 feet, resulting in steep, sparsely vegetated slopes containing a number of leachate seeps and eroded gullies. The highest portion of this fill (possibly elevation 280) was redeposited there from the South Fill during the second expansion of the sewage treatment plant. The Rockaway River has undercut the landfill's banks and exposed waste materials along the steep banks. This was evident during field investigations, especially at the northern end of the North Fill and along the South Fill upstream of the Parsippany-Troy Hills treatment plant.

° South Fill: Most of this site is located southeast of Sharkey Road and is generally bounded on the east by the Rockaway River, on the south by the Parsippany-Troy Hills Sewage Treatment Plant (STP) and the New Whippany River, and on the west by the STP and an adjacent wooded area off Edwards Road. The site also includes the area northwest of Sharkey Road between the two ponds and the Rockaway River. The site is owned by the Township of Parsippany-Troy Hills.

This Fill, excluding the sewage treatment plant, is approximately 29 acres in size. The original treatment plant structures were reportedly built on piles over the landfilled wastes, but most of the wastes were removed from the areas when the two plant expansions were constructed.

The removed material from the first expansion was relocated immediately northwest of the plant where it formed the upper portion of the mount on the South Fill. The fill deposited in this area ranged up to 70 feet high. The mound's side slopes are steep but the earth cover appears to be fairly uniform and, except where some erosion has occurred, to be supporting vegetation. Gas vents are located along the top of the South Fill mound where the redeposition occurred, but some have been vandalized and are inoperative.

Access to the South Fill from Sharkey Road and the areas to the northeast is mostly unrestricted except for gates recently constructed at the entrance of Sharkey Road and one near the North Fill Bridge.

Two ponds are located northwest of the South Fill, adjacent to Sharkey Road. These ponds are reportedly clean and supporting fish, amphibians, and aquatic vegetation, despite the presence of plastics and gas bubbles.

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° Northwest Fill (2 Areas): This site consists of two areas divided by Route 280 and Relocated Edwards Road. One area southwest of Relocated Edwards Road, estimated at 15 acres, is bordered by the New Whippany River to the south, Troy Meadows to the west, and by a heavily-wooded area south of the New Road/Relocated Edwards Road intersection. This site is owned by COMG Realty, c/o Ringlieb. This area is designated Northwest Fill (South of Route 280) and is labeled Northwest Fill (S).

The second area is located northeast of Route 280 and is bounded by Edwards Road to the northeast, the New Whippany River to the southeast, and a wooded area bordering New Road to the northwest. This site, with an estimated area of 11 acres, is owned by Dowel Associates. It is designated as Northwest Fill (North of Route 280) and labeled Northwest Fill (N).

These fill areas have sparse to intermittent soil cover with many large areas of exposed refuse, (including rusted drums) particularly in the portion southwest of Relocated Edwards Road.(Northwest Fill (S)). The topographic relief created by the landfill operations in these areas is not as pronounced as in the North and South Fill areas, generally reaching an estimated elevation 20 to 30 feet above the adjacent swamp to the southwest. Access to these site areas is limited only by the terrain.

° Southwest Fill: This site is located in East Hanover, and is bounded by Ridgedale Avenue to the northwest, a drainage ditch to the southeast, the old Whippany River channel to the southwest, and the relocated New Whippany River to the northwest. This site, with an estimated area of 9 acres, is owned by Wildlife Preserves.

This relatively level area ranges about 10 to 20 feet above the adjacent swampland, and displays generally good soil cover and vegetative growth. Part of the original landfill, this site was reportedly used for the redeposition of approximately 184,000 cubic yards of wastes and cover material from the excavation work for the construction of Route 280 through the landfill. However, according to the recollections of the NJDOT superintendent during the construction period there, some excavated wastes were deposited in the southwest portion of the South Fill off Sharkey Road. Access to the Southwest Fill is limited only by the terrain.

Geology/Physical Description - General

The site is located in the Piedmont Physiographic Province. It i characterized by a swampy lowland with a few surrounding ridge and isolated hills rising above the plain. Most of the area lie

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between the elevations of 170 to 440 feet above mean sea level (msl). Rocks underlying Pleistocene era and younger unconsolidated deposits in this area are predominantly of the Brunswick Formation consisting of red shale and sandstone. Also present in this area, and forming the topographic relief of the Watchung Mountain are Triassic-age Basalt flows.

The Wisconsin glaciation of Pleistocene Age has resulted in significant morphological changes of topography within this physiographic province. During the Pleistocene Era, this area was located near the northwestern shoreline of a very large glacial lake, termed Lake Passaic, bordered by the highlands to the northwest and the second Watchung Mountain to the south and southeast. This lake was fed by outwash from a northerly retreating glacier that formerly occupied this area. The natural drainage outlets for the pre-lake area were to the southeast, near Summit, New Jersey. This outlet area was blocked by glacial moraine during the development of the lake. Lake Passaic grew in size as the glacier retreated northward. The nearest that the Lake Passaic shoreline came to the landfill area was near Boonton, approximately five miles northwest of the site.

As the glacier retreated and Lake Passaic grew, coarser outwash deposits were deposited in areas to the south of the retreating glacial front. Shoreline areas also received sediment-laden runoff from the highlands to the west and the Basalt ridges to the north and east. As the glacier retreated even further northward from this area, silt and varved clay lake deposits accumulated on the floor of the expanding lake.

The estimated maximum surface elevation of Lake Passaic was approximately 356 feet, or about 176 feet above existing land surface in the vicinity of the landfill. When the glacier had retreated as far north as Paterson, a previously ice-blocked drainage outlet in the Watchung Mountain Range was exposed and the lake was terminated. Post-glacial drainage for this area continues to migrate to the north via the Passaic River where it breaches the Watchung Mountains near Paterson. Post-glacial lake erosion and deposition in this area by alluvial processes has continued through the present. Much of the source material for more recent depositional processes include the igneous Precambrian rocks to the north and west and weathering of local Basalt ridges.

Recent Site History

During the 1930's, the site was used as a pig farm, and in 1945, the site began operations as a landfill. Sharkey Landfill received wastes from several counties in northern New Jersey, and in 1972, it was reportedly receiving about 200 truckloads of waste per day. In addition to accepting municipal solid waste, the landfill was allegedly the disposal site for hazardous and/or toxic materials between 1962 and 1969.

The landfill reportedly operated six days a week until a July 6, 1972 order issued by the New Jersey Department of Public Utilities (NJDPU) required the discontinuance of Saturday service at the site to allow necessary time to place sufficient cover material. Landfill operations were discontinued on September 9, 1972.

An unverified report indicates that about 3,000,000 gallons of wastewater of unknown composition was deposited at "Sharkey's Disposal - Pinebrook" between 1972 and 1974. It is not certain that the referenced site is the Sharkey Landfill.

The landfill was relatively inactive until the mid-1970's when excavation began for two expansions of the municipal sewage treatment facility. For the first expansion, the removed material was located to the west of the treatment plant. Several acres of refuse were removed from the South Fill for the second expansion and re-deposited on the North Fill area. The expansion project was completed in 1981 and the site has apparently remained unchanged since that time.

Site Related Complaints and Actions

Dumping at the Sharkey Farms site began about 1945 with very few controls (no fences, pigs freely roaming the site, etc.), but probably because of the relatively isolated, rural siting and initial limited size, there were no recorded complaints. As the operation grew and spread, however, things changed. From 1966 until 1972, a record of steady complaints was registered with various township, county, and state agencies by local residents along New Road and the neighboring section of Montville, by businessmen along Route 46, by people passing through the area, and by local officials. For the most part, complaints involved the odors emanating from the site, but other complaints involved trash encroaching upon the Sharkey Road ROW and blowing on the roads, smoke from landfill fires, height of the mounds of trash, lack of proper cover during fill operations, and dead animals left unburied at the site. In most cases, the complaint was followed by a site inspection, and many times, the complaintant was notified of the inspection results. These complaints seemed to cease when the landfill closed in 1972.

The expansions of the Parsippany-Troy Hills Sewage Treatment Plant during the mid-to-late 1970's brought complaints of a different nature. Because of the landfill disruptions, NJDEP again began periodically inspecting the site in May, 1976. The inspections, which ran through June 1981 when the final inspection was made, primarily noted inadequate cover of the disrupted areas, but also noted leachate flowing from the island site in an October, 1978 report.

Waste Types

The information in this subsection is primarily from the RAMP, with confirmation of the Ciba-Geigy Corp. and Koppers Co., Inc. data provided by NJDEP. Additional information was obtained from NJDEP inspection reports.

Prior to its closure in 1972, Sharkey Farms, Inc. accepted not only municipal wastes, but at least some industrial wastes as well. Information from Ciba-Geigy Corp. of Summit, NJ includes a Selected Substance Report dated November 5, 1980 listing disposal to Sharkey Farms between 1962 and 1969. of toluene (560,000 lbs.), benzene (130,000 lbs.), chloroform (40,000 lbs.), methylene chloride (20,000 lbs.), ethylene dichloride (3000 lbs.) and selenium oxide (100 lbs.).

In response to an EPA Request for Information, Koppers Co., Inc. of Kearny, NJ reported that between 1972 and 1974, their disposal contractors transported approximately 3 million gallons of waste-water, possibly consisting of fungicide and/or coal tar constituents, to "Sharkey's Disposal" in "Pinebrook, NJ". The RAMP noted that "at this time, it is not known whether this is the same site as that described in this report."

Most of the 1972 to 1974 disposal period is subsequent to the landfill's closure but there is no additional information available as yet to explain this possible inconsistency. If these wastes were disposed of at Sharkey's in 1972 prior to its closing, and since the South Fill was reported as filled to capacity at the end of 1970, those Koppers Co., Inc. wastes may be limited to the North Fill island site.

On July 21, 1970, the landfill was officially permitted to accept liquid and solid chemicals and waste oil as well as municipal wastes.

The RAMP noted that "Permit applications filed by Conrad Ringlieb, President of Sharkey Landfill, to the New Jersey Department of Environmental Protection indicate that a wide variety of wastes were accepted at the landfill (NJDEP, 1972). Categories which could possibly include hazardous substances were commercial, industrial, institutional and chemical wastes, and waste oils. No records of specific substances were found."

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Operating Reports filed by Sharkey Farms Inc. with NJDEP for the period from April 13, 1972 to May 10, 1972 indicate a total of approximately 25,700 tons of non-chemical wastes received (90% household wastes, 8% commercial, and 2% industrial wastes), and 1160 tons of "Liquid and/or chemical wastes" which were described as cesspool type. No other reports were obtained from DEP. In addition to aforementioned wastes, sludge from the adjacent Parsippany-Troy Hills Treatment Plant was deposited in the landfill.

BASIS OF STUDY

The disposal of known and unknown quantities of chemical wastes at the Sharkey Site, the location of a public surface water supply downstream, and the potential for groundwater contamination were perceived to present a threat to the surrounding residents and downstream populations because of the potential for hazardous substance discharges to air, groundwater, surface water and biotic resources which could impact off-site populations. Therefore, the NJDEP, in cooperation with USEPA, had established the Sharkey Farms Landfill as a high priority site for performing a Remedial Investigation/Feasibility Study (RI/FS) to fully characterize the environmental risks posed by the Site and to formulate appropriate remedial actions to be undertaken to control unacceptable off-site impacts.

Since there was very limited information available on waste sources suspected dumped at the site and its impact on the surrounding environment, a Remedial Investigation was conducted at the Sharkey Site between July and December 1985 to collect chemical and physical information on the site characteristics and its potential impact on the environment and public. The purpose of the study was to define the level and extent of the contamination at the site and to develop the information needed to evaluate appropriate remedial alternatives.

Prior to this submittal, Tasks 1, 2 and 3A of the seven task scope of the RI/FS were completed and submitted to the NJDEP. The Task 1 Report entitled "Initial Site Investigation and Site Security" was transmitted to NJDEP in December 1984 and described the initial site investigations, site security measures, and construction modifications for the bridge to the North Fill. Initial security measures included the construction of two gates and fencing to prevent trucks and cars from ready access to the North and/or South Fill. One gate is located on Sharkey Road at the entrance of the Fill Area. The second gate is located also on Sharkey Road near the North Fill Bridge just west of the Parsippany-Troy Hills Police Department's firing range.

Task 2 activities included the completion of a site specific Health and Safety Plan (HASP) for the required field activities; the development of a Field Sampling Plan (FSP) to outline the scope of activities and procedures to be employed during field investigations; and a Quality Assurance Project Management Plan (QAPMP) to assure the accuracy and reliability of the raw and synthesized data, analyses and interpretations of the data. These Plans were approved by NJDEP in June 1985.

Task 3A of the RI/FS involved the review of background investigations and the compilation of existing information associated with the site. A review report on the existing information was submitted to NJDEP in May 1985.

REMEDIAL INVESTIGATION CHRONOLOGY

The following is a chronology of the major activities associated with the Remedial Investigation:

- September 1984 - Initial site investigation including reconnaissance and 24 hour air monitoring.
- November 1984 - Electromagnetic survey.

- October 1984 - June 1985 - Approval of site specific plans (HASP, FSP, QAPMP).
- July 1985 - Dry weather water quality survey, including stream flows, surface water samples, sediment sampling, and leachate sampling.
- July - October 1985 - Construction of 26 monitoring wells and hydrogeological investigations.
- November 1985 - Wet weather water quality survey and sampling of monitoring wells, potable wells, soil sampling.
- December 1985 - Completion of monitoring groundwater levels.

OVERVIEW OF REPORT

The following presents an overview of the contents of each Chapter.

- Chapter 1 - Introduction - includes a description of the Site highlighting historical information on the Site, discusses the basis of the RI/FS, and outlines the contents of this report.
- Chapter 2 - Air Investigation summarizes the existing data on air quality for the Sharkey Site.
- Chapter 3 - Subsurface Investigation - presents the extensive study results for the field investigation on geology, groundwater, hydrogeology and soils. This Chapter was prepared by R. E. Wright Associates, Inc. (REWAI), the hydrogeological consultants who conducted these studies and analyzed the field data.
- Chapter 4 - Surface Water Investigation - presents the results of the detailed water quality surveys which included sampling surface waters, sediments and leachates during two periods, dry weather and wet weather conditions. This Chapter was prepared by Hydroqual Inc. (HQI), water quality consultants, who carried out the field surveys and analyzed the survey data.
- Chapter 5 - Summary of Field Investigation Results - highlights the results of the chemical analysis on samples collected on the surface waters,

sediments, leachates, groundwater, potable wells, and soils.

- Chapter 6 - Proposal Response - discusses the analysis of off-site and on-site environmental and public health concerns based on the results of the field investigation. This analysis served as the basis for developing remedial action objectives.

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EPA REGION II
SCANNING TRACKING SHEET

DOC ID # 53761

DOC TITLE/SUBJECT:

SHARKEY FARMS LANDFILL
NJ DEP – HAZARDOUS SITE MITIGATION ADMINSTRATION – SITE LOCATION: JULY 1986 (EXHIBIT 3-1)

THIS DOCUMENT IS OVERSIZED AND CAN BE LOCATED IN THE ADMINISTRATIVE RECORD FILE AT THE

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NEW YORK, NY 10007

2. AIR INVESTIGATION

This Chapter summarizes the information available on air quality at the Sharkey Site. Limited data have been collected on air quality at the Site.

PREVIOUS AIR MONITORING

FIT personnel detected methane on site using an Organic Vapor Analyzer during a site visit conducted June 24, 1982. The ambient air quality was also monitored by NUS personnel during a site visit on April 5, 1983. Monitoring was conducted using an HNU photoionizer equipped with a 11.7 bulb. This instrument will detect the presence of compounds with an ionization potential of less than 11.7, but not methane. The following ranges in parts per million (ppm) were recorded:

Background	3.0
Near surface of seeps	12.0 to 16.4
One foot above seeps	1.2 to 6.4
Ambient air on site	2.0 to 3.0
Water surface*	3.6 to 16.0
Gas vents	4.2 to 7.2

* Readings taken at south end of north fill area at the edge of Rockaway River.

It should be noted that these readings were taken on a day that was cool and windy. Hot days with little wind may tend to increase these readings. No other air monitoring data was found for the site. Note that many of the gas vents installed in the south fill area have been vandalized. There are no vents in the north fill area.

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SITE RECONNAISSANCE/AIR MONITORING; SEPTEMBER, 1984

On September 18, 1984, an initial site reconnaissance was conducted by the RI/FS team. The purpose of this reconnaissance was, in part, to assess the existing air quality and other environmental conditions that would weigh in the preparation of a responsible Health and Safety Plan associated with the completion of subsequent field investigations of the RI/FS.

Throughout this site reconnaissance, which was conducted on each of the four fill areas, REWAI performed an air quality survey using the instruments noted below:

- NHU photoionization detector (organic vapor analyzer)
- MSA Model 2A combustible gas indicated (Explosimeter)
- Solar Electronics, Inc. Model 4 radiation detector

Background levels of organic vapors established at the entrance to the site at Sharkey and Edwards Roads ranged between 1.5 to 3 ppm on the NHU equipped with an 11.7 eV bulb. No anamolous or higher levels were observed in ambient conditions during the reconnaissance of the fill areas. Measurements performed at the surface of leachate seeps at the south end of the North Fill area showed small increases in organic vapor levels to a maximum of 2 ppm above background.

The HNU will not detect the presence of methane. Therefore, the combustible gas indicator, which is calibrated to methane, was used to detect methane emissions at the site during reconnaissance. No anamalous readings were observed above a background L.E.L. (Lower Explosive Limit) of 2%.

Radiation levels observed at the site and in local off-site areas ranged from 0.02 to 0.04 mR (milli-roentgens) per hour. This is considered normal.

A 24-hour air monitoring study was conducted on September 18-19, 1984 by the project team. The main purpose of this survey was to obtain air quality data to establish a basis for determining personnel protection levels during subsequent activities at the site. The survey consisted of the installation of five sampling pumps in various locations on the site. The approximate locations of the air quality sampling points are shown on Exhibit 4-1 (Chapter 4).

These sampling locations were established by the project team to obtain a background sample upwind (to the northwest at location 5), a sample downwind of the North Fill (location 1), and three locations in the area of the North and South Fill. The battery operated air pumps were changed at eight hour intervals. The charcoal sorbent tubes used at each location were also changed at 8 hour intervals. Each sample was subsequently desorbed with methanol and composited to obtain a 24 hour composite sample. These samples were analyzed for the volatile organic priority pollutants.

Samples were collected using SKC charcoal tubes. Analysis was performed on the first segment, for volatile organics only, by Stables-Reuter, Inc. of Camden, NJ. The compounds detected during this survey and their respective ambient air concentrations are presented in Table 2-1.

These recent air quality measurements, indicated that an extremely low probability of respiratory or dermal hazards from air-borne volatile organics exists under ambient conditions.

TABLE 2-1

AIR MONITORING SHARKEY LANDFILL
(September 18 & 19, 1984)

Purgeable Organic Compounds (Method 624)

Constituent	Sample Designation Station A 3548-A	Station B 3548-B	Station C 3548-C	Station C Duplicate
Chloromethane	1	1	1	1
Bromomethane	1	1	1	1
Vinyl chloride	1	1	1	1
Chloroethane	1	1	1	1
Methylene chloride	1	1	1.1	1.3
1,1-Dichloroethylene	1	1	1	1
1,1-Dichloroethane	1	1	1	1
trans-1,2Dichloroethylene	1	1	1	1
Chloroform	1	1	1	1
1,2-Dichloroethane	1	1	1	1
1,1,1-Trichloroethane	1	1	1	1
Carbon tetrachloride	1	1	1	1
Bromodichloromethane	1	1	1	1
1,2-Dichloropropane	1	1	1	1
trans-1,3-Dichloropropene	1	1	1	1
Trichloroethylene	1	1	1	1
Dibromochloromethane	1	1	1	1
Benzene	1	1	1	1
1,1,2-Trichloroethane	1	1	1	1
cis-1,3-Dichloropropene	1	1	1	1
2-Chloroethylvinyl ether	1	1	1	1
Bromoform	1	1	1	1
1,1,2,2-Tetrachloroethane	1	1	1	1
Tetrachloroethylene	1	1	1	1
Toluene	1	1	1	1
Chlorobenzene	1	1	1	1
Ethyl Benzene	1	1	1	1

Results are expressed in micrograms of constituent. All constituents were less than 1 ug which is shown as 1 in the Table, except for methylene chloride for Station C (1.1 ug and 1.3 ug).

NOTE: Table taken from Sharkey RI/FS Health and Safety Plan
Samples analyzed by Stablex - Reutter Inc.

Station A - A1 Station D - A4
Station B - A2 Station E - A5
Station C - A3 Station F - Trip Blank

TABLE 2-1
(Continued)

AIR MONITORING SHARKEY LANDFILL
(September 18 & 19, 1984)

Purgeable Organic Compounds (Method 624)

Constituent	Sample Designation Station D 3548-A	Station E 3548-B	Station F 3548-C	Method Blank
Chloromethane	1	1	1	1
Bromomethane	1	1	1	1
Vinyl chloride	1	1	1	1
Chloroethane	1	1	1	1
Methylene chloride	1	1	1	1
1,1-Dichloroethylene	1	1	1	1
1,1-Dichloroethane	1	1	1	1
trans-1,2Dichloroethylene	1	1	1	1
Chloroform	1	1	1	1
1,2-Dichloroethane	1	1	1	1
1,1,1-Trichloroethane	1	1	1	1
Carbon tetrachloride	1	1	1	1
Bromodichloromethane	1	1	1	1
1,2-Dichloropropane	1	1	1	1
trans-1,3-Dichloropropene	1	1	1	1
Trichloroethylene	1	1	1	1
Dibromochloromethane	1	1	1	1
Benzene	1	1	1	1
1,1,2-Trichloroethane	1	1	1	1
cis-1,3-Dichloropropene	1	1	1	1
2-Chloroethylvinyl ether	1	1	1	1
Bromoform	1	1	1	1
1,1,2,2-Tetrachloroethane	1	1	1	1
Tetrachloroethylene	1	1	1	1
Toluene	1	1	1	1
Chlorobenzene	1	1	1	1
Ethyl Benzene	1	1	1	1

Results are expressed in micrograms of constituent. All constituents were less than 1 ug which is shown as 1 in the Table, except for methylene chloride for Station C (1.1 ug and 1.3 ug).

NOTE: Table taken from Sharkey RI/FS Health and Safety Plan
Samples analyzed by Stablex - Reutter Inc.

Station A - A1 Station D - A4
Station B - A2 Station E - A5
Station C - A3 Station F - Trip Blank

TABLE 2-1
(Continued)

Purgeable Organic Compounds (Method 624)

Spike Recovery Data

Constituent	SR10252-4 plus Spike Amount of Spike, ug	% Recovery
Methylene chloride	1.0	121
1,1-Dichloroethylene	1.0	61
1,1-Dichloroethane	1.0	81
Chloroform	1.0	90
1,2-Dichloroethane	1.0	122
1,1,1-Trichloroethane	1.0	82
Bromodichloromethane	1.0	109
1,2-Dichloropropane	1.0	87
trans-1,3-Dichloropropene	1.0	97
Trichloroethylene	1.0	73
Benzene	1.0	103
Dibromochloromethane	1.0	88
1,1,2-Trichloroethane	1.0	113
cis-1,3-Dichloropropene	1.0	111
Bromoform	1.0	109
Tetrachloroethylene	1.0	73
Toluene	1.0	69
Chlorobenzene	1.0	66
Ethyl Benzene	1.0	69

3. SUBSURFACE INVESTIGATION

This Chapter presents the results of the field investigations on the geology, groundwater, hydrogeology and soils for the Sharkey Farms Landfill. The Chapter was prepared by R.E. Wright Associates, Inc. (REWAI) who were the hydrogeological consultants on the Project Team. The contents of this Chapter include: data analysis and interpretation of the geology and subsurface site conditions and hydrogeology; chemical characterization of the site, including groundwater sampling, soil sampling, and electromagnetic survey; and conclusions and recommendations.

1.0 INTRODUCTION

1.1 Scope of Report

This is a report on field investigations performed by R. E. Wright Associates, Inc. (REWAI) for the Sharkey Farms Landfill Remedial Investigation and Feasibility Study (RI/FS). The scope of these field investigations, Task 3B of the RI/FS, was first detailed in a proposal submitted to the New Jersey Department of Environmental Protection (NJDEP) by the joint venture of Alfred Crew Consulting Engineers, Inc. (ACCE) and Hazen and Sawyer, PC (H&S) on April 18, 1984. This proposal was submitted in response to a Request For Proposal (RFP) issued by the NJDEP on February 27, 1984.

Prior to this submittal, Tasks 1, 2, and, 3A of the seven task scope of the RI/FS were completed. The Task 1 Report entitled "Initial Site Investigation and Site Security" was issued by the joint venture on October 10, 1984. Task 2 activities included the completion of a site specific Health and Safety Plan (HASP) for subsequent field activities; the development of a Field Sampling Plan (FSP), to outline the scope of activities and procedures to be employed during field investigations; and a Quality Assurance Project Management Plan (QAPMP) to assure the accuracy and reliability of the raw and synthesized data, analyses and interpretations of the data.

Task 3A of the RI/FS included the completion of background investigations to compile existing information associated with the site. As a result of background investigations, the scope of originally proposed site investigations was altered significantly. This was due primarily to new information concerning the geologic characteristics of the sediments beneath the site. Therefore, the draft Task 2 FSP, HASP, and QAPMP package, submitted in October of 1984, required substantial modification, particularly the FSP. Following a period of plan restructuring and negotiations with the NJDEP, the final FSP was submitted on June 12, 1985.

The completed FSP provided the delineation of Task 3B activities as indicated below:

Task 3B Field Investigation

FSP SECTION	DESCRIPTION
3.2	Air Quality Investigations
3.3	Soil/Leachate Investigations
3.3.1	EM Survey
3.3.2	Soil Sampling
3.4	Monitoring Well Construction
3.5	Aquifer Testing
3.5.1	Borehole Geophysics
3.5.2	Groundwater Sampling
3.5.3	Pumping Tests
3.5.4	Slug Tests
3.5.5	Flow Direction
3.5.6	Groundwater Level
- - -	Data Analysis
3.6	Water Quality Investigation
3.6.1	Sampling *
3.6.2	Flow Measurements
- - -	Data Analyses
3.7	Potable Well Investigations
3.8	Hazardous Substance Inventory
3.9	Site Maps

* Sampling includes leachate, surface water, sediment, and treatment plant effluent.

The contents of this report include Task 3B investigations completed by REWAI. Concurrent field investigations completed by HydroQual, Inc., ACCE or H & S are not included in this report. These concurrent field investigations include:

FSP SECTION	DESCRIPTION
3.2	Air Quality Investigations
3.6	Water Quality Investigation
3.6.1	Sampling
3.6.2	Flow Measurements

Base mapping for the site (FSP Section 3.9) was coordinated by ACCE and H & S. Additional base mapping detail such as monitoring well locations, geology, and hydrogeologic information, which is included in this report, has been prepared by REWAI.

In the preparation of this report it is assumed that the reader is familiar with, or has ready access to, information prepared in the Task 2 Pre-investigation Activities package (HASP, FSP and QAPMP). Reference to these documents in this report is therefore made without attachment. The following introductory sections, however, provide basic site orientation and background information. Much of the following introductory material has

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been derived from the RAMP, or obtained during background investigation activities (Task 3A) of this RI/FS.

1.2 Site Location, History, and Physical Description

1.2.1 Location

The Sharkey Landfill site is located 1/2 mile southwest of Pinebrook, New Jersey, at 40°50'57" north latitude and 74°20'40" west longitude in the township of Parsippany - Troy Hills, Morris County, New Jersey (Figure 1.2-1). The entrance to the primary fill areas is located at 1139 Edwards Road on the eastern border of Parsippany - Troy Hills and Montville Townships.

1.2.2 Geology/Physical Description - General

The site is located in the Piedmont Physiographic Province. It is characterized by a swampy lowland with a few surrounding ridges and isolated hills rising above the plain. Most of the area lies between the elevations of 170 to 400 feet above mean sea level (msl). Rocks underlying Pleistocene era and younger unconsolidated deposits in this area are predominantly of the Brunswick Formation (Triassic-age) consisting of red shale and sandstone. Also present in this area, and forming the topographic relief of the Watchung Mountain are Triassic-age Basalt flows (Figure 1.2-2).

The Wisconsin glaciation of Pleistocene Age has resulted in significant morphological changes of topography within this physiographic province. During the Pleistocene Era, this area was located near the northwestern shoreline of a very large glacial lake, termed Lake Passaic, bordered by the highlands to the northwest and the second Watchung Mountain to the south and

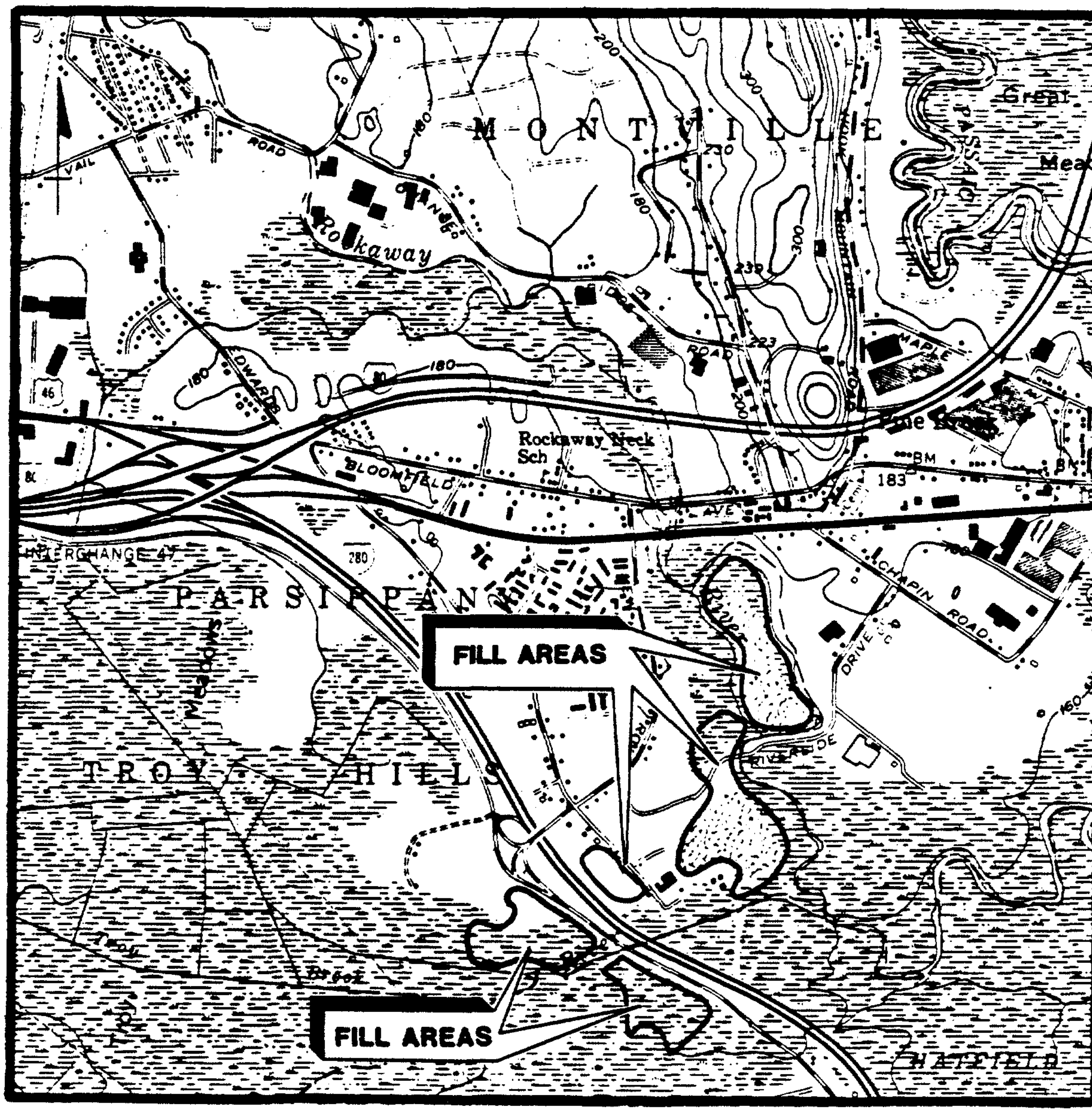

FIGURE 1.2-1

SHARKEY LANDFILL LOCATION PLAN

0 2000'
SCALE

r.e. wright associates, inc.

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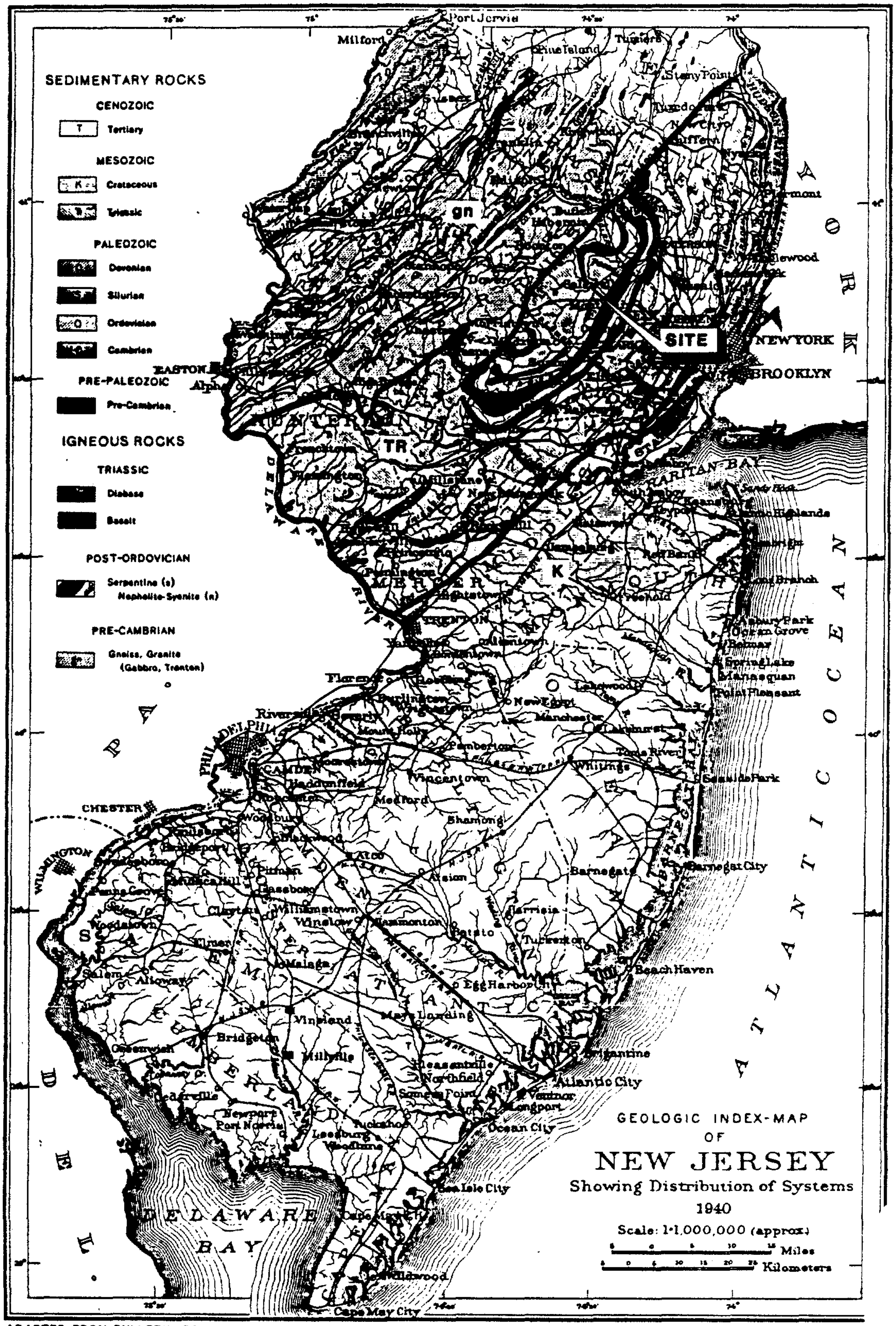

ADAPTED FROM BULLETIN 50, PLATE 1, N. J. DEPARTMENT OF CONSERVATION AND DEVELOPMENT, 1940.

FIGURE 1.2-2

GEOLOGY OF NEW JERSEY

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southeast. This lake was fed by outwash from a northerly retreating glacier that formerly occupied this area. The natural drainage outlets for the pre-lake area were to the southeast, near Summit, New Jersey. This outlet area was blocked by glacial moraine during the advancing stages of the glacier, thereby allowing the development of the lake (Figure 1.2-3). Lake Passaic grew in size as the glacier retreated northward. The nearest that the lake Passaic shoreline came to the landfill area was near Boonton, approximately five miles northwest of the site.

As the glacier retreated and Lake Passaic grew, coarser outwash deposits were deposited in areas to the south of the retreating glacial front. Shoreline areas also received sediment-laden runoff from the highlands to the west and the Basalt ridges to the north and east. As the glacier retreated even further northward from this area, silt and varved clay lake deposits accumulated on the floor of the expanding lake.

The estimated maximum surface elevation of Lake Passaic was approximately 356 feet (Lewis, 1914), or about 176 feet above existing land surface in the vicinity of the landfill. When the glacier had retreated as far north as Paterson, a previously ice-blocked drainage outlet in the Watchung Mountain Range was exposed and the lake was terminated. Post-glacial drainage for this area continues to migrate to the north via the Passaic River where it breeches the Watchung Mountains near Paterson. Post-glacial lake erosion and deposition in this area by alluvial processes has continued through the present. Much of the source material for more recent depositional processes include the igneous Precambrian rocks to the north and west and weathering of local Basalt ridges.

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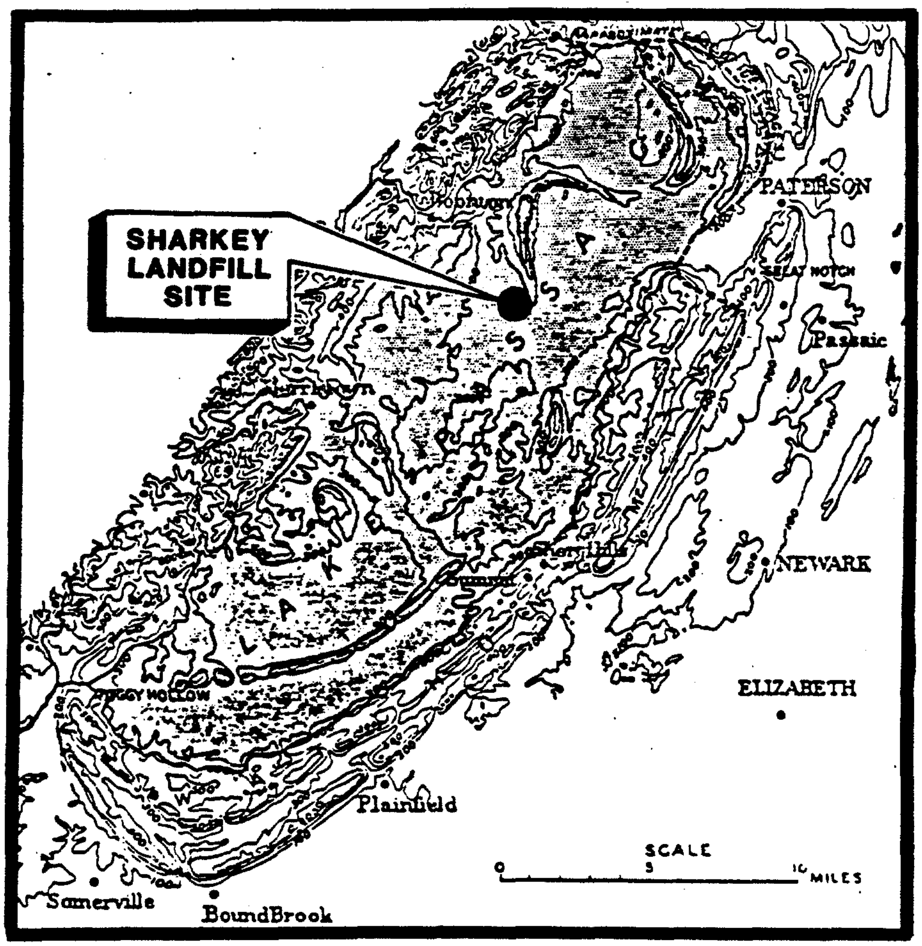

SOURCE: BULLETIN 50, THE GEOLOGY OF NEW JERSEY, N. J. DEPARTMENT OF CONSERVATION AND DEVELOPMENT, 1940

FIGURE 1.2-3

MAXIMUM STAGE OF LAKE PASSAIC.

ALL OUTLETS EXCEPT THAT AT MOGGY HOLLOW WERE EITHER BLOCKED BY ICE OR FILLED WITH DRIFT

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The study area is divided into four sections. These are shown on Plate 3-1 and are defined as:

1. North Fill: This area, about 39 acres in size, is an island completely surrounded by the Rockaway River. The North Fill contains a maximum thickness of 80 feet of fill with intermittent soil cover material. The side slopes in the north fill area are sparsely vegetated and contain a number of leachate seeps and erosion gullies. The Rockaway River is also undercutting the landfill banks and exposing waste material.

2. South Fill: This area is approximately 64 acres in size, and includes the Parsippany - Troy Hills Sewage Treatment Plant. This plant was constructed in the South Fill after several acres of landfill material were removed. The excavated debris was redeposited on the North Fill. The South Fill area has a fairly uniform soil cover which is supporting vegetation.

3. Northwest Fill: This area is split by Route I-280. Generally, the area has sparse to intermittent soil cover. The topographic relief created by fill operations in these areas is not as pronounced as in the north and south fill areas, generally reaching an elevation of 20 to 30 feet above the adjacent Hatfield Swamp located to the south and west.

4. Southwest Fill: This area is located west of I-280, and it displays generally good soil cover and vegetation growth. The cover material is this area was

reportedly obtained from excavations during the construction of I-280.

1.2.3 Recent Site History

During the 1930's, the site was used as a pig farm, and in 1945, the site began operations as a landfill. Sharkey Landfill received wastes from several counties in northern New Jersey, and in 1972, it was reportedly receiving about 200 truckloads of waste per day. In addition to accepting municipal solid waste, the landfill was allegedly the disposal site for hazardous and/or toxic materials between 1962 and 1969.

The landfill reportedly operated six days a week until a July 6, 1972 order issued by the New Jersey Department of Public Utilities (NJDPU) required the discontinuance of Saturday service at the site to allow necessary time to place sufficient cover material. Landfill operations were discontinued on September 9, 1972.

An unverified report indicates that about 3,000,000 gallons of wastewater of unknown composition was deposited at "Sharkeys Disposal - Pinebrook" between 1972 and 1974. It is not certain that the referenced site is the Sharkey Landfill.

The landfill was relatively inactive until 1979, when excavation began for the expansion of the municipal sewage treatment facility. Several acres of refuse were removed from the South Fill and re-deposited on the north fill area. The expansion project was completed in 1981 and the site has apparently remained unchanged since that time.

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An analysis of aerial photography of the landfill vicinity by the Bionetics Corporation, Warrenton, Virginia was completed for the U. S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory in September of 1984. This analysis spans the period between May, 1957 and March, 1974 and provides valuable historical perspective on the development and land uses in the area during that period. The document is entitled "Site Analysis Sharkey Landfill Parsippany and Troy Hills, New Jersey".

1.2.3.1 Site-Related Complaints and Actions

The Sharkey Landfill site began operations in 1945. From 1966 until 1972, there was a record of steady complaints to various township, county, and state agencies about conditions at the landfill. Some of these complaints were registered by residents, particularly residents living along New Road. Other complaints were made by businessmen along Route 46, by people passing through the area, and by local officials.

For the most part, complaints involved the odor emanating from the site, although some people complained about blowing trash on the roads, smoke from landfill fires, the height of the mounds of trash, lack of proper cover during fill operations, and dead animals left uncovered at the site. These complaints seem to have ceased when the landfill closed in 1972.

1.2.3.2 Waste Types

In addition to receiving municipal refuse from surrounding communities, Sharkey Landfill accepted industrial wastes from Ciba-Geigy Company. Records indicated that toluene (560,000 lbs.), benzene (130,000 lbs.), chloroform (40,000 lbs.), methylene chloride (20,000 lbs.), and dichloroethylene (3,000 lbs.) were disposed of at the site. Additional deposits of industrial, commercial, institutional, and chemical wastes of undefined sources, composition, and quantity are suggested, but unverified, by reports.

Hazardous solid wastes were also deposited in Sharkey Landfill; however no information is available concerning the specific areas in which these substances were placed. It has been reported, however, that no evidence of chemical disposal was found during the excavations for expansion of the sewage treatment plant in the south fill area.

1.2.3.3. Previous Groundwater Quality Investigations

Prior to this RI/FS very limited groundwater investigations have been conducted at the site. Prior to disrupting and removing waste materials during sewage treatment plant expansion, four monitoring wells were installed to determine the waste materials' potential to contaminate groundwater at a new site. Groundwater samples taken December 1, 1977, reportedly contained chemical constituents at "concentrations normally associated with a solid waste facility accepting domestic and commercial waste." These wells no longer exist.

On April 2, 1980, U.S. Environmental Protection Agency, Region II personnel sampled two nearby private drinking water wells. The analytical results are presented in Table 1-1. Because of a power failure during analysis of the volatile organics sample from the Pizzi residence well, no results are available for that fraction. These wells are located approximately 1/2 mile south-southwest of the landfill.

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TABLE 1-1

PIZZI AND STEPPEL WELL ANALYTICAL RESULTS
April 2, 1980

Compound	Concentration (ppb)
Bis(2-ethylhexyl)phthalate	<10
Butyl benzyl phthalate *	<10
Methylene chloride *	<10
Arsenic	0.4 to 2.4
Beryllium	3 to 4
Cadmium	3
Chromium	10
Copper	10 to 30
Lead	60
Nickel	10
Silver	10
Zinc	54 to 120
Antimony	60
Selenium	0.7 to 2.0
Thallium	0.4
Mercury	0.2 to 0.49

* Steppel well only

Note; Samples collected by EPA Region II

2.0 FIELD INVESTIGATIONS - PHYSICAL CHARACTERIZATION OF THE SITE

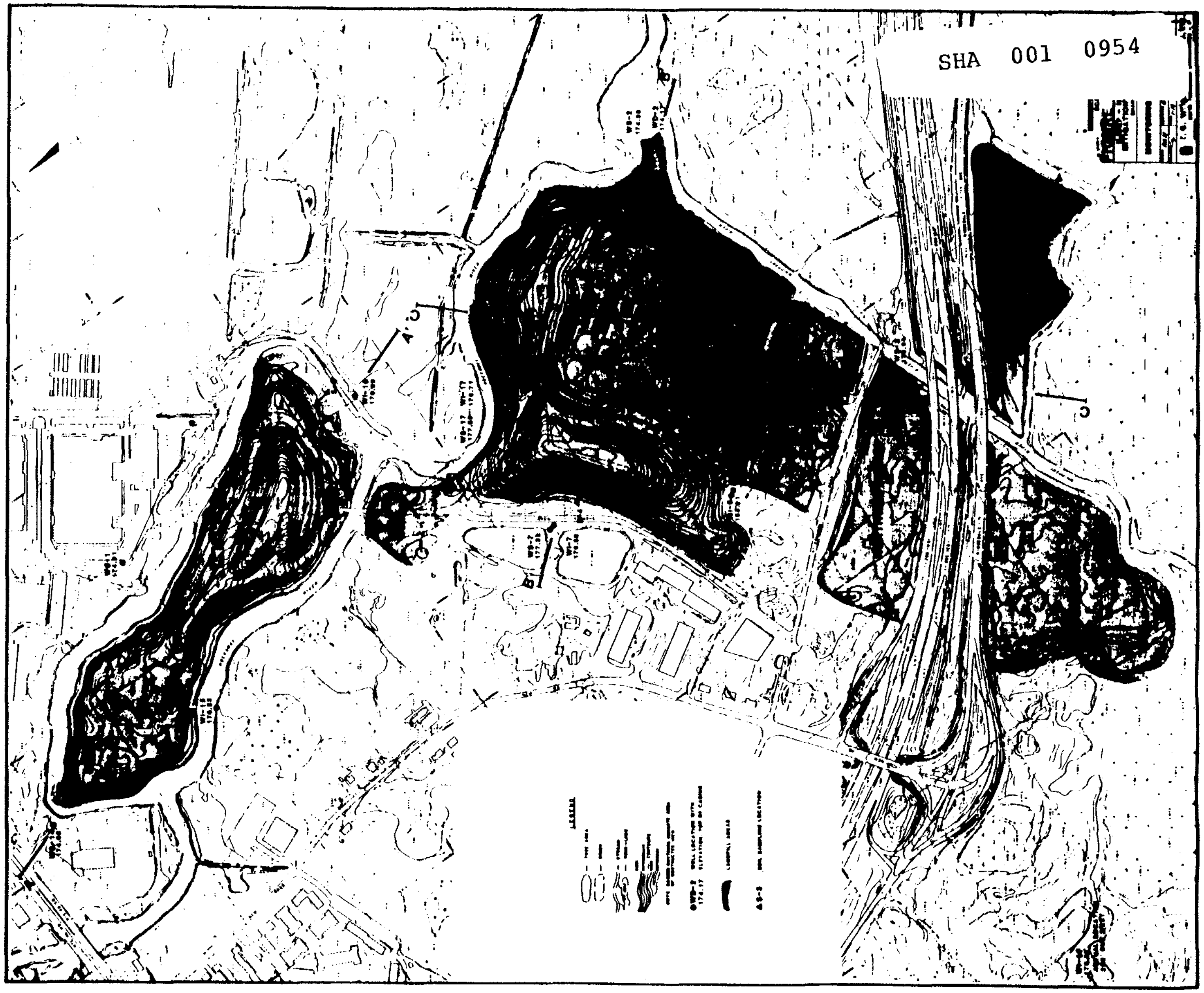
2.1 Monitoring Well Construction

2.1.1 Purpose/Scope

During Task 3B, Field Investigations, 27 test borings were completed. All but one of these borings were completed as groundwater monitoring wells, placed at 17 locations across the site, as shown on Figure 2.1-1. The remaining well was abandoned.

These monitoring wells were installed to obtain groundwater chemistry and hydrogeologic information from two separate water-bearing zones beneath the site. The existence of these zones was tentatively established during background investigations. Records of previous foundation test borings completed in the South Fill area, prior to the expansion of the sewage treatment plant, indicated that a thick, silty gray varved clay layer was present throughout much of the study area. This unit would separate the unconsolidated aquifer into an upper (shallow) and lower (intermediate) unit.

Fourteen monitoring wells have been completed in the upper or shallow aquifer. The upper aquifer is defined as the first permeable saturated zone below the surface. These wells are designated as WS-series wells on Figure 2.1-1. Ten of the twenty-six monitoring wells have been completed as intermediate wells, termed WI-series wells. These wells are screened in the lower aquifer, within the first permeable zone below the confining varved clay unit. Two WD-series wells, or deep wells, were also completed. These wells were installed at the base of



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the lower aquifer. The deep wells penetrated the entire lower aquifer, terminating at the bedrock surface.

The twenty-six (26) completed monitoring wells were placed at seventeen (17) sites across the study area. Each site has a designated number. Each well is distinguished by appending the site number to its series designation. For example, WS-8 is a shallow well installed at Site 8; WI-8 is an intermediate well completed at Site 8.

2.1.1.1 Variations From The FSP - The number and series designations of completed monitoring wells differ from the FSP. Planned Well WD-1, although advanced to bedrock, was not completed in the lower aquifer because the permeable lower aquifer thickness between the gray varved clay unit and the bedrock was insufficient to allow for 1Ø feet of well screen installation. This well was therefore backfilled and abandoned in accordance with FSP methods. The abandoned boring location is adjacent to completed Well WS-1, shown on Figure 2.1-1 (and Plate 3-1).

Thirteen intermediate wells and ten shallow wells were planned. However, intermediate wells planned at Sites 2, 14, and 1 were completed as shallow wells due to the thinning or absence of a lower aquifer at these locations. As a result, the intermediate, or WI-series, wells were reduced from 13 to 1Ø, and the number of shallow wells increased from 1Ø to 13. Shallow Well WS-11, in the central portion of the North Fill, was added to the project at the request of the NJDEP, bringing the total number of shallow wells to 14.

2.1.2 Well Construction Methods

The methodology used in the construction of the monitoring wells is detailed in Section 3.4 of the FSP. Some variations from the specified FSP construction methods did occur, however.

2.1.2.1 Variations From The FSP - The major variations from the provisions of the FSP concerning well construction were:

1. At many of the WI- and WD-well sites, instead of proceeding initially using mud-rotary techniques, a pilot boring was first constructed by advancing hollow-stem augers through the (upper) shallow aquifer, terminating within the upper 5 to 1Ø feet of the gray varved clay unit. Continuous split-spoon sampling was performed through this interval to obtain geologic information. This pilot hole was then abandoned by backfilling with a bentonite/concrete backfill. Abandoned Pilot boring logs are indicated by the suffix "A" (example WI-7A).

   Mud-rotary drilling in an adjacent offset hole was then advanced without sampling into the clay unit. Steel casing was installed and grouted, per the specifications of the FSP. Split-spoon sampling and hole advancement through and below the varved clay unit, terminating in the lower aquifer was then performed in compliance with the FSP, using mud-rotary techniques.

2. Bentonite or sand thicknesses, installed during well construction, varied slightly from well to well due to inherent hydrogeologic conditions. These minor var-

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iations are reflected in the well logs which are discussed in Section 2.1.3.

The objectives of the well construction process were met, regardless of the FSP variation. The major objectives, generally stated, include:

- o Maintaining and providing a competent seal between the upper and lower aquifers, where a natural confining layer, such as the gray varved clay unit was present.
- o Providing representative monitoring points in the selected aquifer from which chemical sampling and hydrologic observations could be performed.
- o Obtaining the best possible geologic information from material samples obtained.

Throughout well construction activities, communication between REWAI, the NJDEP site manager and the NJDEP site geologist was maintained. These variations were approved by the NJDEP prior to implementation. Materials used in the construction of monitoring wells were decontaminated in accord with Section 6.1.2 of the FSP.

2.1.3 <u>Results - Monitoring Well Construction</u>

The 26 monitoring wells were installed between July 29 and October 23, 1985. Graphic summary logs portraying the construction of each well, including geologic information, are presented in Appendix B-1. Copies of the original geologic field logs for each of the 27 borings and abandoned offset borings are provided in Appendix B-2. Table 2-1 provides a summary of monitoring well coordinate locations and elevations of pertinent intervals.

2.1.3.1 Deep Wells - Three deep (WD-) borings were completed at Sites 1, 2, and 3. These sites are shown on Figure 2.1-1. As noted previously, Well WD-1 was not constructed; this boring was abandoned since an insufficient thickness of lower aquifer was present at this site to permit well-screen installation. The geologic log of the materials encountered in abandoned Boring WD-1 is included in Appendices B-1 and B-2.

Wells WD-2 and WD-3 were advanced to bedrock, as shown on the logs in Appendix B-1. Basalt bedrock was encountered in each of these wells. The red shale or sandstone of the Triassic Brunswick Formation was not encountered.

At each of these deep well locations a thick gray varved clay unit was identified. The elevations at the top and base of this clay unit are shown both on the well log and Table 2-1. At Site 1, the varved clay unit was separated from the basalt bedrock by approximately five feet of reddish-brown gravelly clay. No fill was encountered at this site. At Site WD-2, approximately 2Ø feet of reddish-brown sandy silt with inter-fingered sand and gravel was present between the gray varved clay and the basalt bedrock. At Well WD-3, approximately 29 feet of dark reddishbrown sand and gravel was present between the gray varved clay and the bedrock.

2.1.3.2 Intermediate Wells - Ten intermediate (WI) wells were constructed. Each of these wells completely penetrated the gray varved clay unit. However, Well WI-15 was also advanced to bedrock. At each of the nine remaining intermediate well

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Table 2-1
Sharkey Landfill
Monitoring Well Coordinates and Elevations

Approximate Elevations (ft. msl.)

Monitoring Well	Top/ Casing (ft.)	Ground (ft.)	Top of Clay	Base of Clay	Top of Bedrock	Base of Screen	Base of 8-inch Casing	Static Water Level 12/16/85	Elev. Total Depth	Coordinates N	Coordinates E	NJDEP Well Permit No.
WD-1	------	172.0	154.0	132.0	127	------	-----	------	114.0	-----------	------------	----------
WS-1	174.01	172.09	154.9	-----	-----	156.0	-----	167.72	-----	736539.6983	2089472.8473	25-26382-0
WS-2	174.38	172.39	-----	-----	-----	147.4	-----	165.48	145.4	733369.7776	2089690.4606	25-26384-6
WD-2	174.17	171.97	139.5	123.0	103.4	106.5	134.0	167.77	98.5	733361.1789	2089695.5544	25-26383-8
WI-3	174.20	171.02	157.0	123.0	-----	107.0	147.0	167.87	104.0	732993.2804	2088142.7077	25-26386-2
WS-3	173.94	171.53	156.5	-----	-----	156.3	-----	160.24	151.5	732995.3970	2088160.9600	25-26387-1
WD-3	174.82	171.42	156.4	125.4	75.4	77.4	147.4	167.99	73.4	732990.1387	2088155.0825	25-26385-4
WI-4	175.58	173.83	157.8	131.8	-----	113.8	139.8	167.68	111.8	732292.8193	2088203.2980	25-26388-9
WS-4	176.58	173.63	158.6	-----	-----	158.6	-----	166.12	156.8	732284.3709	2088216.4401	25-26377-3
WI-5	184.17	181.77	157.8	112.8	-----	83.8	147.8	168.27	77.8	732972.4976	2087173.5429	25-26376-5
WS-5	184.02	181.98	-----	-----	-----	154.0	-----	169.72	152.0	732980.6729	2087157.3577	25-26378-1
WI-6	185.21	182.24	150.7	126.5	-----	108.2	142.2	168.31	106.2	733981.8294	2088144.5182	25-26379-0
WS-6	184.78	182.31	-----	-----	-----	160.3	-----	168.82	157.3	733971.3222	2088153.6906	25-26380-3

Table 2-1 Cont.
Sharkey Landfill
Monitoring Well Coordinates and Elevations

Approximate Elevations (ft. msl.)

Monitoring Well	Top/ Casing (ft.)	Ground (ft.)	Top of Clay	Base of Clay	Top of Bedrock	Base of Screen	Base of 8-inch Casing	Static Water Level 12/16/85	Elev. Total Depth	Coordinates		NJDEP Well Permit No.
WI-7	176.58	174.65	150.1	122.6	-----	105.6	144.6	167.48	100.7	734766.6048	2088479.6961	25-26381-1
WS-7	177.32	174.54	-----	-----	-----	152.5	-----	171.07	150.5	734770.1537	2088483.5658	25-26363-3
WI-8	177.70	175.62	154.6	115.6	-----	100.6	147.6	168.10	95.6	735437.8071	2088935.2710	25-26364-1
WS-8	178.45	176.15	-----	-----	-----	153.1	-----	165.81	152.2	735432.6878	2088932.0595	25-26365-0
WS-9	195.45	193.60	151.6	-----	-----	151.6	-----	172.81	141.6	737221.6749	2088771.4544	25-26366-8
WI-10	179.33	177.81	157.3	123.8	-----	103.8	152.8	168.08	101.8	733800.3521	2085161.4213	25-26367-6
WS-11	228.19	225.77	150.8	-----	-----	157.8	-----	166.69	155.8	736200.3059	2089174.2294	25-26368-4
WS-12	199.73	197.03	153.0	-----	-----	153.6	-----	166.83	151.0	735705.7218	2089619.4714	25-26369-2
WS-13	184.68	182.01	-----	-----	-----	152.5	-----	166.68	150.0	735531.8502	2089132.8957	25-26370-6

Table 2-1 Cont.
Sharkey Landfill
Monitoring Well Coordinates and Elevations

Approximate Elevations (ft. msl.)

Monitoring Well	Top/ Casing (ft.)	Ground (ft.)	Top of Clay	Base of Clay	Top of Bedrock	Base of Screen	Base of 8-inch Casing	Static Water Level 12/16/85	Elev. Total Depth	Coordinates		NJDEP Well Permit No.
WS-14	174.66	172.64	154.1	136.6	136.6	155.6	-----	166.76	152.6	737489.2169	2088655.5609	25-26371-4
WI-15	170.53	169.02	152.0	131.0	119.0	120.0	146.0	168.11	114.0	736555.7077	2088678.2147	25-26372-2
WI-16	170.89	169.33	132.3	114.3	-----	99.8	125.3	168.06	93.3	735215.4236	2089507.2014	25-26373-1
WI-17	176.71	174.65	135.6	114.6	-----	97.6	130.7	167.91	93.6	734662.7035	2089104.1917	25-26374-9
WS-17	177.85	174.97	-----	-----	-----	156.6	-----	166.27	153.0	734665.2079	2089095.2758	25-26375-7

Notes

Coordinate and elevation data provided by VEP Engineers and Surveyors, Inc.
*Each Screen Interval = 10 ft.
Some lithologic information presented for individual wells obtained from adjacent abandoned borings, explaining units encountered below indicated well depth

locations, sufficient permeable aquifer thickness was present beneath the clay to allow well screen installation without further penetration of the lower aquifer.

Landfill wastes (fill) was encountered at all but four of the intermediate well sites; WI-7, WI-10, WI-15, and WI-16. Fill in the remaining sites ranged in thickness from 3 feet at Site WI-3, to 20 feet at WI-17.

2.1.3.3 Shallow Wells - Fourteen shallow (WS-) wells were constructed. Bedrock was encountered at four of these sites. At three of these locations bedrock was found during the construction of an adjacent deep, or intermediate well, previously discussed (WD-1, WD-2, and WD-3).

The fourth shallow well site where bedrock was encountered is Site WS-14. As noted in Section 2.1.1, an intermediate well was planned for this site; however, it was found that bedrock was in near contact with the bottom of the gray varved clay unit at this site. Therefore, the original boring was backfilled, and an offset shallow well (WS-14) was constructed.

Each of the shallow wells are completed above the gray varved clay unit. Well screens were installed at the intervals indicated on Table 2-1 and shown on the well logs in Appendix B-1.

Fill was encountered at all but three of the shallow well locations; WS-1, WS-7, and WS-14. The fill thicknesses for the remaining wells ranged between 3 feet at Site WS-3 to 73 feet at Site WS-11.

2.1.3.4 Stratification Of Unconsolidated Deposits - The stratification, or layering of deposits encountered on this site is discussed in greater detail in Section 2.3. However, five discrete strata are identifiable across the site:

- Fill - Includes refuse and cover materials.
- Upper alluvial deposits - Post-Lake Passaic deposits, includes Quaternary (recent) sediments.
- Gray Varved Clay - Glacial Lake Passaic deposits (lacustrine).
- Lower (Reddish-brown) glacial outwash deposits.
- Bedrock - Basalt: Nearby Brunswick Formation contact inferred from published mapping.

The gray varved clay is marked by intermittent lenses of silt and fine sand deposits. Although it appears to represent a confining unit of very low permeability and considerable thickness, averaging 2Ø to 25 feet, it is not a homogeneous unit.

The basalt bedrock appears to consist of an upper weathered and broken zone, underlain by competent material. Although only basalt was encountered in the drilling, published geologic mapping idicates that most of this area is underlain by soft red shales and sandstones of the Brunswick Formation. The basalt is associated with a topographic ridge extending to the north from this vicinity (Watchung Mountain).

2.1.3.5 <u>Shelby Tube Samples/Permeability Testing</u> - Eight (8) Shelby tube samples were collected during monitoring well construction. The manner of collection and analysis was performed in accordance with the provision of the FSP. These samples, comprising two-foot intervals were taken within the gray varved clay unit. A constant-head permeability test was performed on each sample. The sample site and depth interval for each of the eight samples, keyed to the laboratory report number, is shown on Table 2-2. The laboratory reports on these tests are included in Appendix B-3.

As shown above, the average permeability value for this clay is approximately 1.33×10^{-7} cm/sec. This is roughly equivalent to 2.8×10^{-3} gpd/ft^2. This is well within the expected range for a clay, exhibiting low permeability.

2.1.3.6 <u>Sieve Analyses</u> - Four (4) sieve analyses were performed on samples selected from the monitoring well construction effort. The samples tested were as follows:

Well No.	Depth Interval (Ft.)
WD-3	48 - 52
WI-8	64 - 68
WI-7A	12 - 18
WI-16	24 - 30

The laboratory results of these tests are included in Appendix B-4. The samples selected from Sites WI-16, and WI-7 were chosen to represent the upper gray silty sand unit above the varved clay unit. The samples from Sites WI-8 and WD-3 were selected to represent the lower red-brown silty sand deposits found underlying the gray varved clay unit. The Shelby tube

TABLE 2-2

SHARKEY LANDFILL
Summary of Permeability Values - Shelby Tube Samples

Well No.	Depth Top of Sample/ Approx. Elev.(ft)	Permeability (cm/sec)	Ref. Lab No.
* WD-1	22/150	1.47×10^{-7}	ST-8
WI-3	25/146	1.08×10^{-7}	ST-1
WI-3	35/136	1.49×10^{-7}	ST-2
WI-5	40/142	1.16×10^{-7}	ST-5
WI-5	48/134	1.28×10^{-7}	ST-6
WI-8	30/146	1.37×10^{-7}	ST-3
* WI-14 X 1	24/149	1.48×10^{-7}	ST-7
WI-17	45/130	1.30×10^{-7}	ST-4
Average		1.33×10^{-7}	

* Abandoned Boring

sample from Well WD-3 represents a gradational sample between silty sand and gravelly sand in the lower unit.

Comparison of these reports indicate that the particle size distribution of the upper aquifer deposits, (Wells WI-16 and WI-7A), is generally coarser than the lower aquifer material. These materials can be described as fine to medium sand with minor amounts of fine gravel.

The samples from the lower unit (WI-8 and WD-3) show a distinct skewing to the finer particle range. The sample from Well WD-3 has the coarser texture of the two, with 25% medium sand and minor gravel. The sample from WI-8, however, is dominantly silt or clayey silt, with little or no fine to medium sand.

2.2 Borehole Geophysics

2.2.1 Purpose/Scope

A series of geophysical logs were obtained for each of the monitoring wells completed for this RI/FS, including gamma ray, density, and caliper. The purpose of the borehole geophysical survey was to acquire stratigraphic data to supplement the geologic log obtained during well construction. In addition to these three basic logs a temperature log was performed at each well site that the lower glacial outwash aquifer was penetrated. To observe temperature variations within the north fill, Wells WS-9, WS-11 and WS-13 were also logged. Copies of all geophysical logs are included in Appendix B-5, accompanied by a brief discussion of logging interpretations and capabilities.

2.2.2 Results

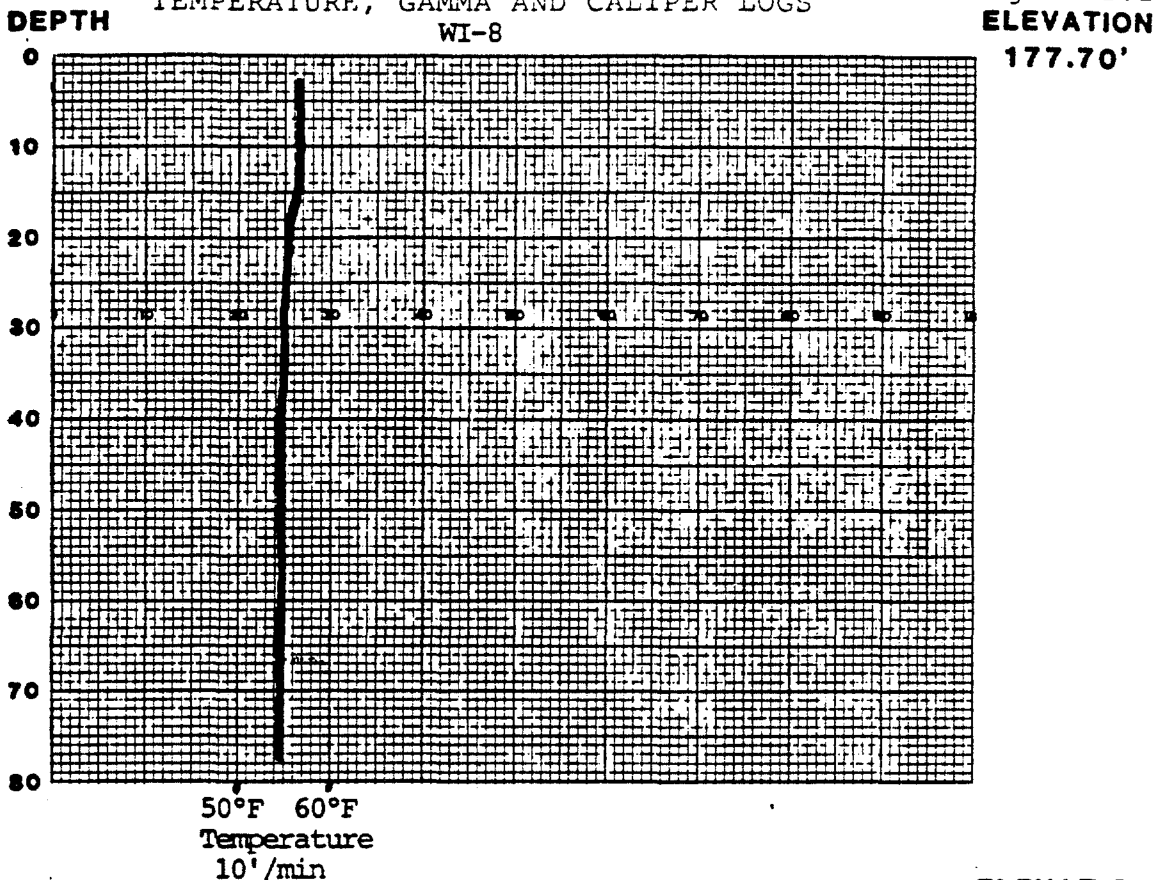
2.2.2.1 Caliper Logs - The caliper survey indicated that all casing joints are aligned and no separations or irregularities are evident in the inner casing walls. The caliper logs also showed screen intervals comparable to the elevations shown on the well logs (Appendix B-1).

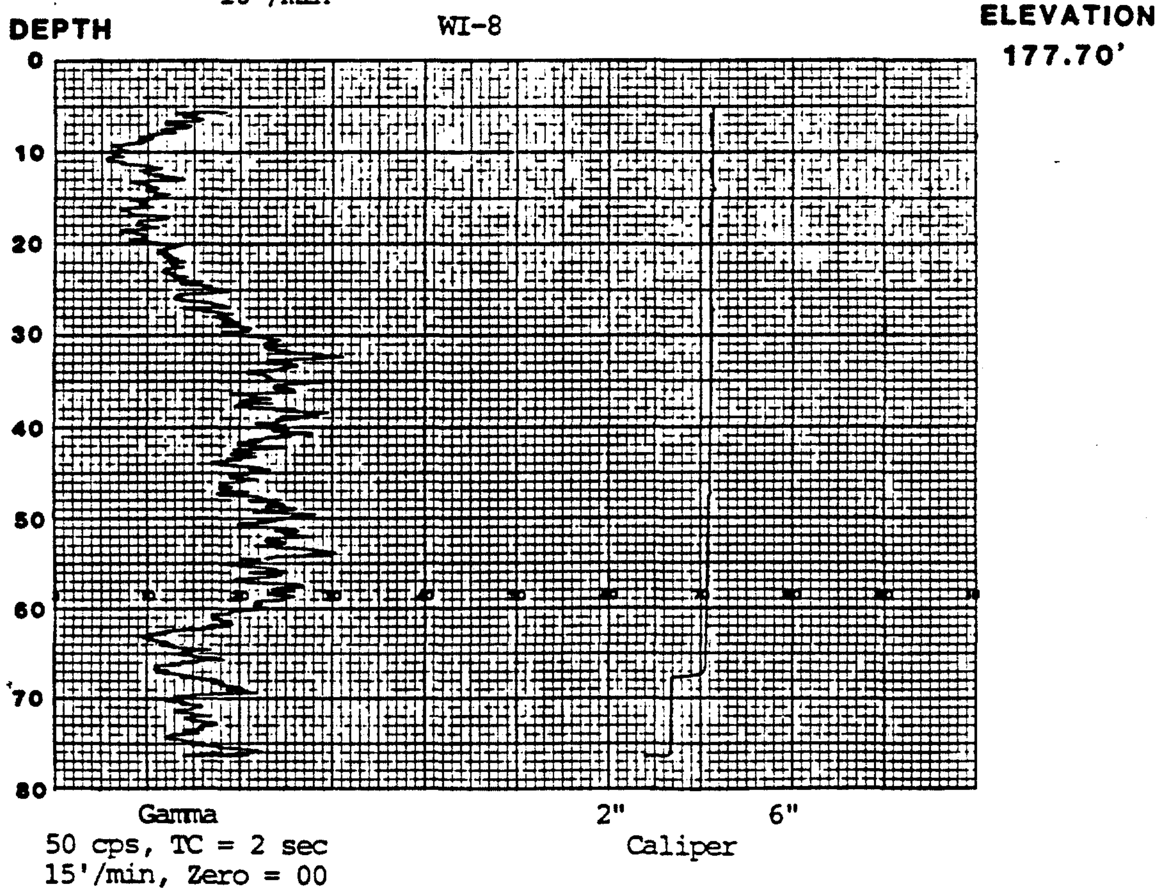
2.2.2.2 Gamma Logs (Natural Gamma) - The fill and upper aquifer materials produced natural gamma emissions in the range of approximately 5 to 1Ø counts per second (cps). Coarse sand and gravel and minor clay intervals, encountered in wells across the site, do not appear to correlate. However, an overall textural transition zone between the upper alluvial aquifer and the gray varved clay was often found, indicated on the gamma log by a gradual increase in gamma intensities; from approximately 1Ø cps to 2Ø cps. This textural transition tends to correlate well with the geologic log (Appendix B-2), where small sand, silt and occasional clay lenses alternate, gradually fining downward to the underlying varved clay unit. An example of this transition can be seen on the gamma log of WI-8 (Figure 2.2-1) between the depth of 2Ø to 3Ø feet. In this well, the top of the varved clay unit was geologically logged at a depth of 23 feet.

The average gamma counts produced by the varved clay is approximately 23 cps. Gamma intensities in this unit reach 25 to 3Ø cps and fall to a low of 15 cps. The variations in gamma counts correspond to respective increases and decreases in clay content. In this survey, four distinct zones of increased gamma intensities, or dense clay zones, have been found within the varved clay unit. These zones occur at all but one site, WS-14.

TEMPERATURE, GAMMA AND CALIPER LOGS

Figure 2.2-1





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With this exception, the four zones (marker beds) can be correlated across the site.

The range in amplitude of gamma ray counts in the varved clay marker beds appear greatest along the northern boundaries of the south fill area, and at Monitoring Well sites WI-15, and WI-16. The range decreases to the south, but these intervening layers can nevertheless be identified. Table 2-3 shows the elevations that these marker beds have been found on the gamma logs (Appendix B-5). The identification of these dense clay marker beds further indicates that the unit is not homogeneous and there are zones of relative increases and decreases in permeability within the unit. However, the high correlation factor also indicates that the unit is continuous across the site.

The gamma ray log indicates that the lower glacial outwash unit contains relatively less silt and clay material at the northern end of the South Fill. A sharp gamma transition between the varved clay and lower glacial outwash unit is also evident in this area. Gamma ray intensities drop suddenly from approximately 23 cps to approximately 10 cps. To the south, the transition becomes less distinct. In Monitoring Well WD-3, for example, the gamma log shows almost no change in clay content between the gray varved clay and the dark reddish-brown lower aquifer, geologically logged during well construction at a depth of 49.5 feet.

2.2.2.3 Density Logs - The density logs provide relative changes in density between the layered deposits. Due to interferences caused by well casing and screen intervals, density values generated by these logs may only be used for relative comparison, not actual formation density.

TABLE 2-3

SHARKEY LANDFILL
VARVED CLAY UNIT MARKER BED ELEVATIONS FROM NATURAL GAMMA LOGS

Well	Marker Bed 1	Marker Bed 2	Marker Bed 3	Marker Bed 4
WD-2	143.0 to 141.0	140.0 to 138.0	134.0 to 127.0	125.0 to 122.0
WD-3	155.0 to 152.0	151.0 to 148.0	147.0 to 141.0	139.0 to 128.0
WI-4	160.0 to 153.5	149.5 to 147.5	146.5 to 144.5	138.0 to 134.5
WI-5	157.5 to 153.0	144.5 to 139.0	138.5 to 137.0	135.0 to 127.0
WI-6	Not Present	143.0 to 142.0	137.0 to 133.0	130.0 to 126.5
WI-7	143.5 to 138.5	135.0 to 131.5	130.0 to 125.5	123.5 to 120.0
WI-8	147.5 to 141.5	139.5 to 135.5	130.0 to 123.0	120.0 to 117.5
WI-10	158.5 to 154.5	153.5 to 150.5	149.0 to 140.0	136.5 to 130.0
WI-15	147.5 to 143.5	143.5 to 142.5	139.0 to 137.0	136.5 to 135.0
WI-16	131.0 to 128.0	127.0 to 125.0	124.5 to 120.0	117.5 to 116.5
WI-17	138.0 to 137.5	130.0 to 127.0	124.5 to 122.0	117.0 to 116.0

Note: All elevations in ft. (msl)

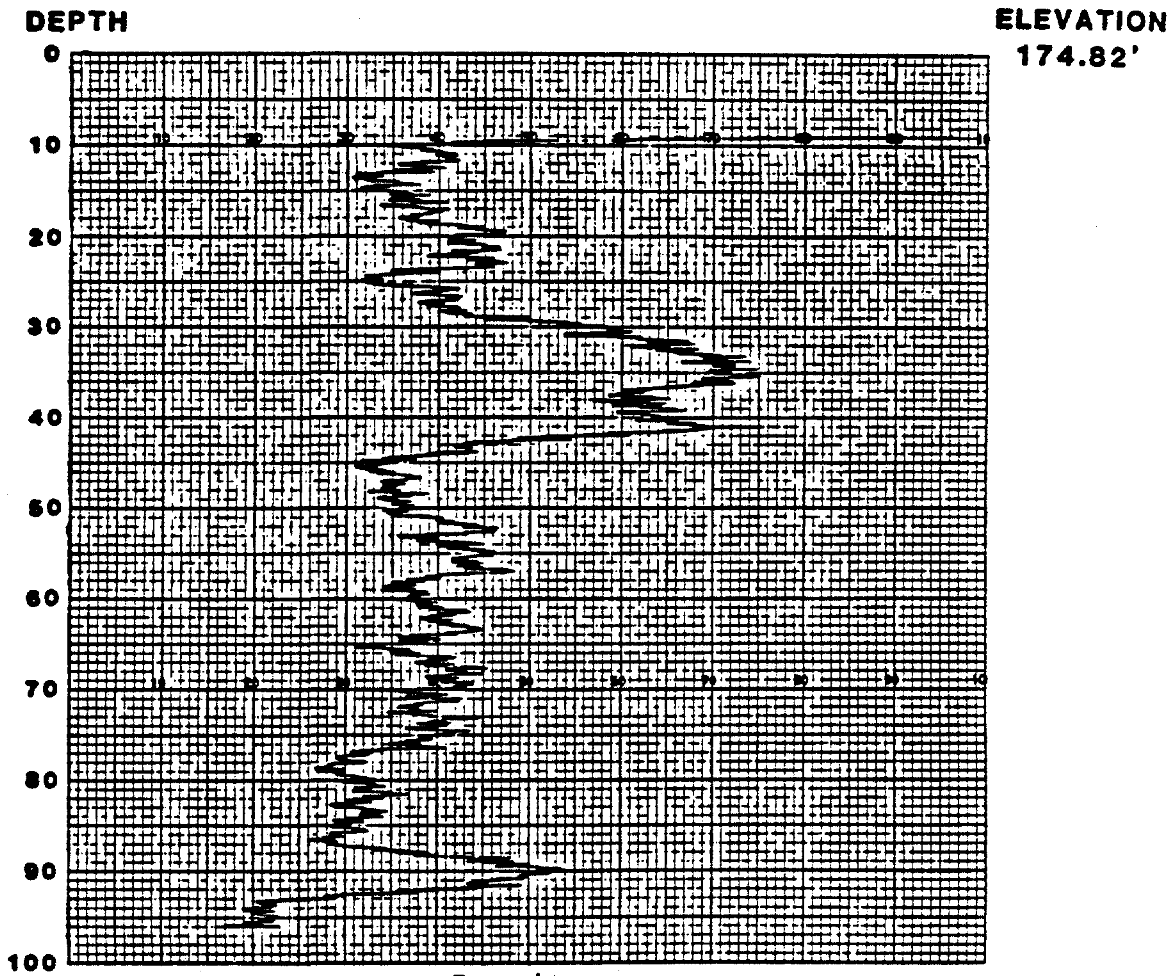
Density logs obtained from shallow wells on the North Fill show that the fill has a relative density ranging from 2.05 grams/ cubic centimeter (g/cc) to 2.25 g/cc, averaging approximately 2.1 g/cc. The shallow aquifer was found to have a relative density between 2.5 to 2.7 grams per cubic centimeter (g/cc), averaging approximately 2.55 g/cc. The lower aquifer has a density ranging from 2.55 g/cc to 2.15 g/cc, with an average relative density of approximately 2.35 g/cc.

The varved clay unit between the upper and lower aquifers, has a relative density ranging from approximately 1.9 g/cc to 2.5 g/cc. Its average density is approximately 2.1 g/cc. A particularly notable low density zone appears in the clay unit across the site at a depth of approximately 5 to 10 feet below the top of the unit. An example of this low density zone is shown on the density log on Well WD-3 (Figure 2.2-2) at a total depth of 30 feet.

2.2.2.4 Temperature Logs - A temperature log was obtained at each Intermediate or Deep well site. In addition, three of the four Shallow wells on the North Fill (WS-9, WS-11, and WS-13) were also logged. Table 2-4 shows the maximum, and minimum temperatures observed in these wells, with corresponding elevations. This table also shows the temperatures observed within the screened interval of each well.

None of the logs show temperature anomalies within the screened intervals. The coolest temperatures, however, were found within the screened intervals; temperature generally decreasing with depth. This type of temperature gradient is partially due to the net warming effect of the heat transmitting steel casing which extends from the well-screen to the surface. Two Intermediate Wells, WI-5 and WI-17, had temperatures which do not appear

DENSITY LOG
OF
WD-3



Density
500 cps, TC=1 sec
15'/min, Zero = 00

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TABLE 2-4

SHARKEY LANDFILL
MONITORING WELLS - TEMPERATURE VARIATIONS

Monitoring Well	Maximum Temperature		Minimum Temperature		Screened Inverval	
	Temp. °F	Elev. (ft.)	Temp. °F	Elev. (ft.)	Temp. °F	Elev. (ft.)
WD-2	56.0	148.0	55.0	104.0	55.0	104.0
WD-3	59.0	166.0	55.0	80.0	55.0	80.0
WI-4	56.6	167.5	53.8	114.0	55.0	80.0
WI-5	66.3	184.0	61.8	83.0	61.8	83.0
WI-6	60.0	167.0	57.0	110.5	57.0	110.5
WI-7	60.0	164.5	55.0	105.0	55.0	105.0
WI-8	56.5	162.5	55.0	100.0	55.0	100.0
WI-10	57.0	169.0	53.0	153.0	53.0	105.0
WI-15	55.3	120.5	55.3	120.5	55.3	121.5
WI-16	57.5	170.5	55.3	118.0	55.3	100.0
WI-17	66.0	150.0	61.3	111.5	61.3	99.0
WS-9	77.3	175.5	73.0	150.5	73.0	150.5
WS-11	89.0	185.0	77.0	225.0	88.0	157.5
WS-13	58.0	152.5	58.0	152.5	58.0	152.5

3-33A

consistent with respect to the other Lower aquifer wells. Warmer temperatures within the screened intervals of these wells (61.25° F) suggest that fluid communications may exist nearby with the generally warmer shallow aquifer in the vicinities of these wells. These wells are also in the vicinity of large fill areas. The decomposing refuse may also be inducing a thermal influence on the lower aquifer in these areas.

The fluid in Well WS-11, on the North Fill was the warmest found on site, with a maximum temperature of 89° F. Fluid in WS-9 reached a temperature of 73.25° F. These anomalies are an indication of thick layers of decaying fill material in the shallow aquifer. Well WS-13 is also on the North Fill; however, it had a maximum fluid temperature of 58° F. This well penetrated a smaller thickness of fill and is in very close proximity to the Rockaway River, which may exert a cooling effect.

2.3 Data Analysis and Interpretation - Geology/Subsurface Site Conditions

Five distinct material types, based upon depositional environments, have been encountered in subsurface exploration on this site. These include:

- o Fill.
- o Upper (Gray) alluvial deposits.
- o Gray varved clay.
- o Lower (Reddish-brown) glacial outwash deposits.
- o Bedrock.

Figure 2.3-1 shows three cross sectional views through the site, depicting each of the above units. The cross section locations are shown on Figure 2.1-1, Plate 3-1 and on several figures introduced in this report section. The subsection to follow will describe the observed physical characteristics of each of these units, utilizing information obtained through combined field investigations.

2.3.1 Bedrock

The predominant bedrock in this area, according to published mapping, is the Brunswick Formation, which consists of Triassic Age red shale with interbedded sandstone units. Also occurring in this region are ridge forming basalt flows. During the construction of the monitoring wells at this site, the Brunswick Formation (red shale) was not encountered. The basalt was encountered in Wells WI-15, WI-14A, WD-1, WD-2 and WD-3. The most extensive penetration of the bedrock during the installation of monitoring wells was in Well WD-1 (abandoned) where approximately 10 feet of bedrock core was obtained. From the conditions of this core and observations while drilling at the other locations, the basalt bedrock has a characteristic gray color, is very hard, and becomes weathered only very near the surface, reaching structural competence at very small penetration depths. The basalt is probably characterized by well developed vertical joint patterns, common to basalt formations.

In addition to the RI/FS monitoring well information, data from reports prepared by Joseph S. Ward, Inc. (Ward) between 1970 and 1974 as part of the foundation study for the Parsippany-Troy Hills sewage treatment plant expansion were used to estimate the relief of the bedrock surface. Also used were boring logs prepared for the New Jersey State Highway Department (NJHD) by

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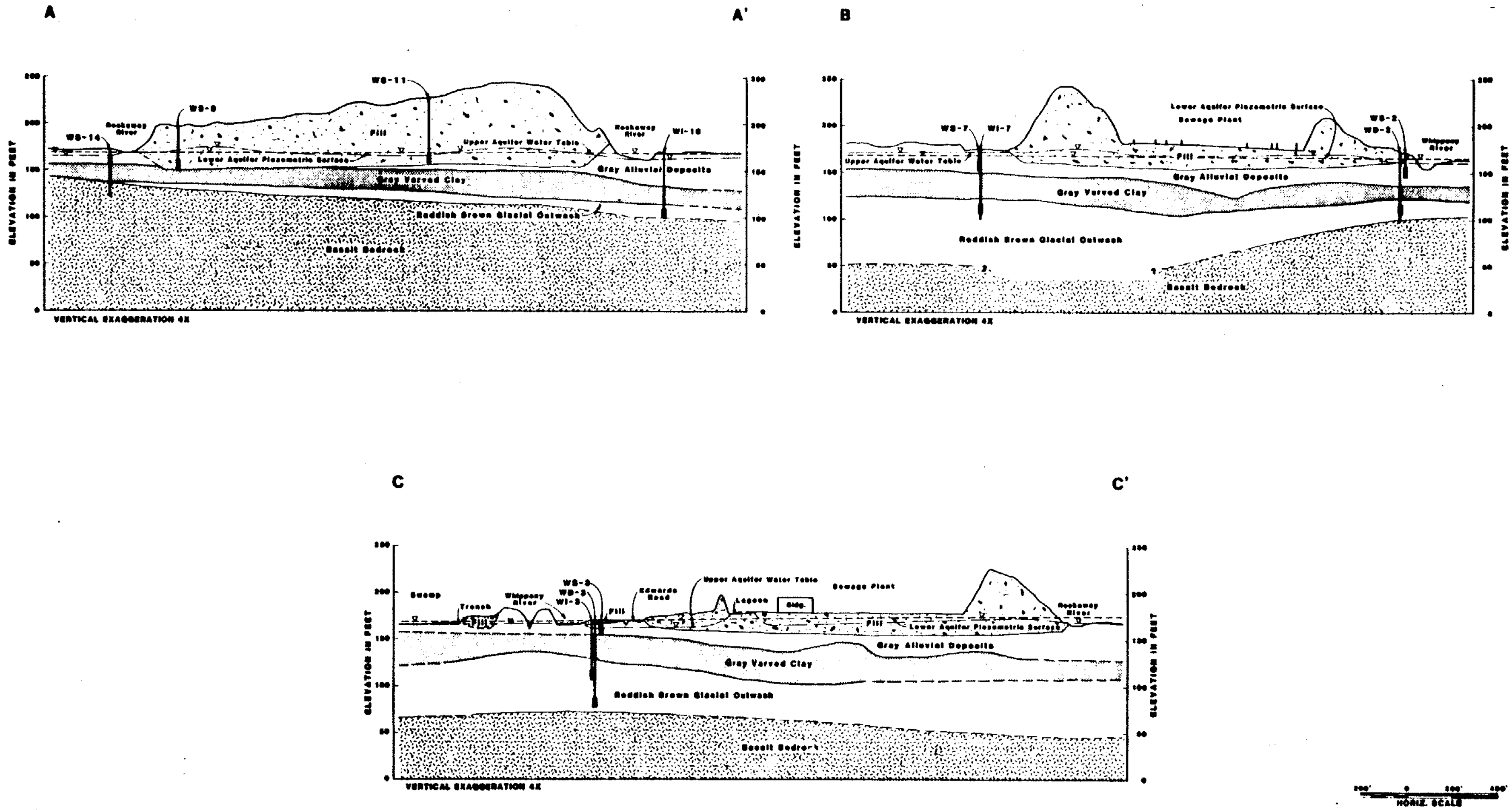


FIGURE 2.3-1

NOTE:

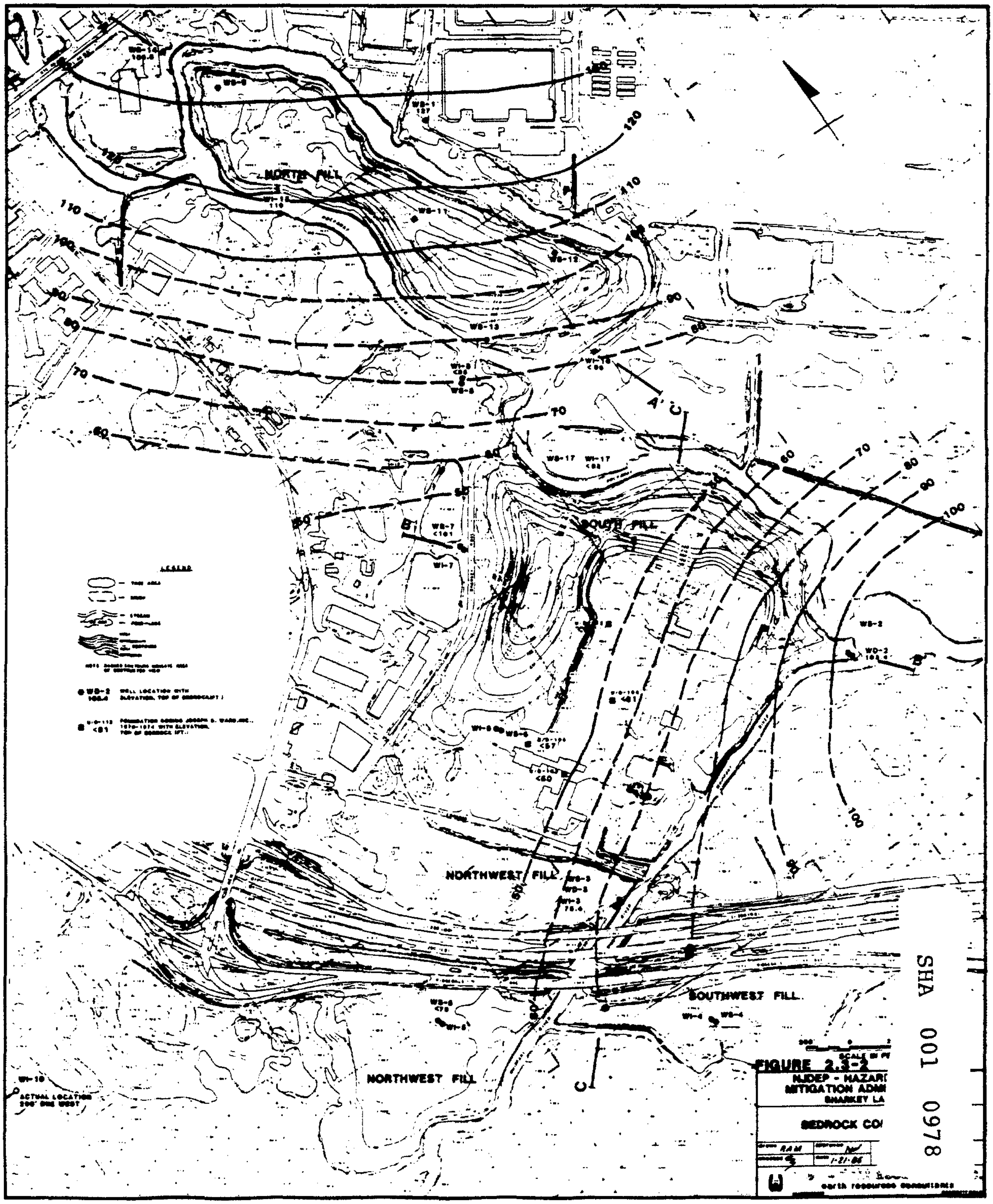
BASALT BEDROCK INFERRED FROM BORING DATA: BRUNSWICK FORMATION (SHALE) CONTACT MAY BE PRESENT

NJDEP - HAZARDOUS SITE MITIGATION ADMINISTRATION SHARKEY LANDFILL			
CROSS SECTIONS			
drawn RAM	approved	drawing no.	8480-010-C
checked	date 1-22-88		
r. e. wright associates, inc. earth resources consultants			

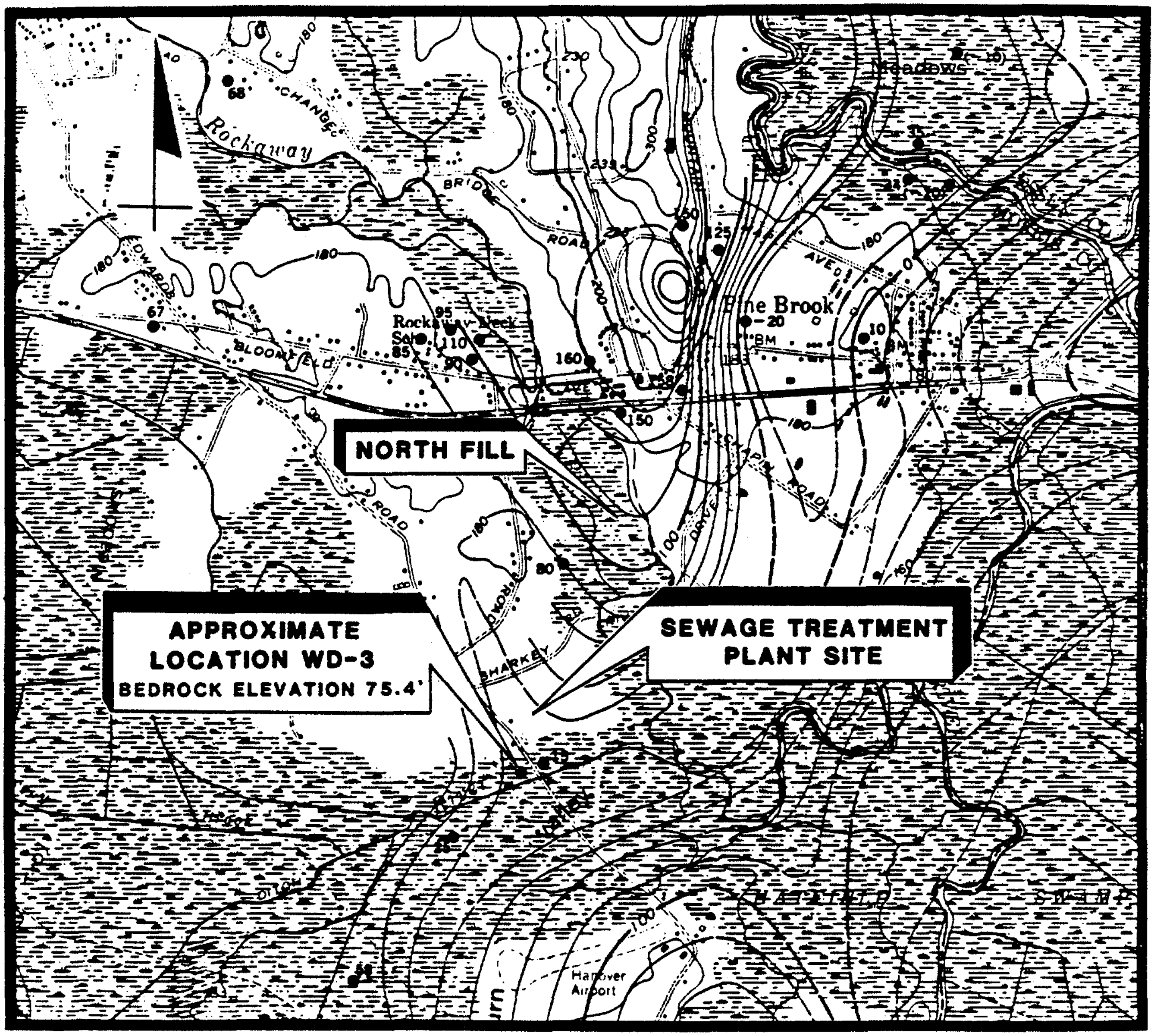
Warren George, Inc. in 1964, prior to the construction of I-28Ø. Copies of selected logs from these sources are included in Appendices D-1 and D-2, respectively. The combined data has been used in the preparation of a Bedrock Contour Map (Figure 2.3-2).

It should be noted that the bedrock contours shown on Figure 2.3-2 are very interpretative. Reliable bedrock data for much of the immediate study area is lacking. A publication by the U. S. Geological Survey (USGS) entitled "Map I-549, Bedrock Topography of Eastern Morris and Western Essex Counties, New Jersey" provides a structural interpretation very similar to that shown on Figure 2.3-2; however, the USGS interpretation (Figure 2.3-3) references a bedrock elevation of 15 feet msl near the present location of Monitoring Well WD-3. Bedrock was encountered at Well WD-3 at an elevation of 75.4 feet msl. As a result, the depth of the bedrock channel indicated on the USGS map has not been confirmed by this study.

The interpretation shown on Figure 2.3-2 does not provide a solution, or closure, for the two opposing bedrock "ridges" that appear to enter the site from the south (near WD-2) and north (beneath the North Fill area). The data is insufficient to confirm the presence of a bedrock channel proceeding to the northeast between these opposing ridges, nor does the data prohibit a projected closure or joining, of the opposing ridges into a continuous unit underlying the whole area, trending north-south. The bedrock contour map, however, projects a northeast to southwest sloping channel, or depression beneath the South Fill. This interpretation, however, does not correspond well with the USGS regional mapping.


NORTH FILL
SOUTH FILL
NORTHWEST FILL
SOUTHWEST FILL
NORTHWEST FILL
FIGURE 2.3-2
BEDROCK CO
earth resource consultants

SHA 001 0978



NOTE: FROM MAP I-549 BEDROCK TOPOGRAPHY OF EASTERN MORRIS AND WESTERN ESSEX COUNTIES, NEW JERSEY. PUBLISHED BY THE U. S. GEOLOGICAL SURVEY, 1968.

FIGURE 2.3-3

USGS MAPPING OF BEDROCK SURFACE - VICINITY OF SHARKEY LANDFILL

0 2000'
SCALE

SHA 001 0979

Accurate delineation of the bedrock contour and the basalt/Brunswick Formation contact would require additional subsurface investigation. At present, this information is not critical to the objectives of the RI/FS.

2.3.2 Lower Glacial Outwash Deposits

The deposits lying between the gray varved clay and the bedrock are termed lower glacial outwash deposits. This unit can be generally characterized as red to reddish-brown silty sands with occasional interbedded gravel and coarse sand. These materials were deposited as outwash material from the nearby retreating glacial front, scouring underlying Brunswick Formation materials (see Section 1.2). The thickness of the unit is largely dependent on bedrock relief which has not been adequately delineated. However, on the basis of information available, its minimum thickness ranges from approximately 2 to 5 feet in the vicinity of Wells WS-14 and WS-1 at the north end of the study area. At Site WD-3 to the south, this lower unit is approximately 50 feet thick and consists primarily of medium to coarse sand and gravel.

From monitoring well geologic logs, and geophysical well log interpretations, this unit generally appears to grade upward to a finer material, eventually fining to a sandy silt, and in some areas to a reddish-gray silty clay. The increasing distance of the northward retreating glacial front from this area during the Pleistocene Era, and therefore the increasing distance that glacially derived outwash would have to travel, induced the overall gradual fining of transported materials.

Eventually, as glacial retreat continued and the area became less of a repository for direct outwash material, lake deposits began to accumulate. The characteristic red coloration of coarser glacial outwash slowly changed to the gray coloration of the lake clay deposits. The probable source area for these gray sediments were Precambrian igneous rocks of the highlands and nearby basalt flows, although gray to black colors typically dominate lake bottom sediments due to the general lack of oxygen.

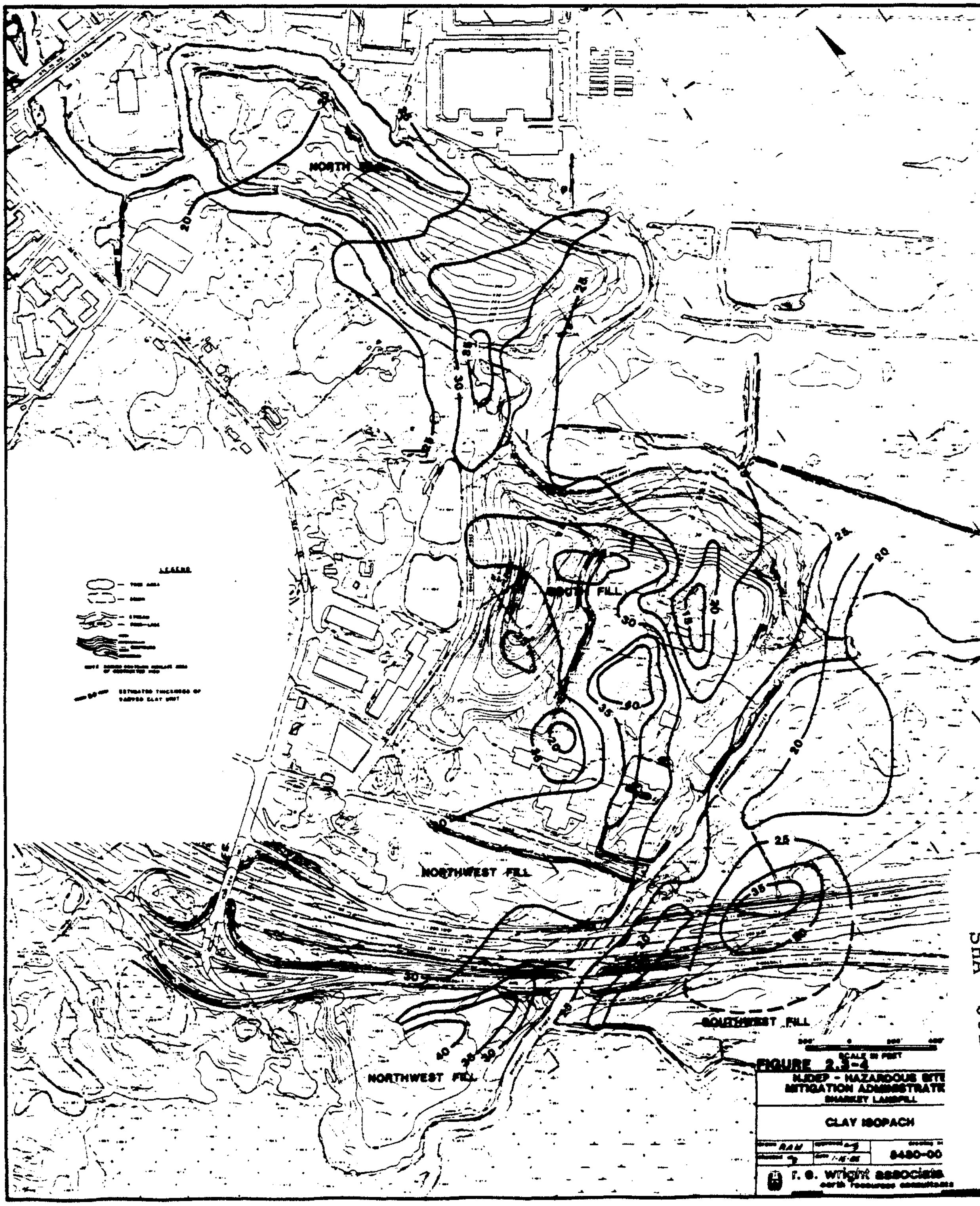
As discussed in Section 2.1, particle size analysis was conducted on two samples from the lower unit encountered in Wells WD-3 and WI-8. Results of these analyses are included in Appendix B-4. The finer materials selected from Well WI-8 for analysis are representative of the upper horizons of this outwash unit.

2.3.3 Gray-Varved Clay

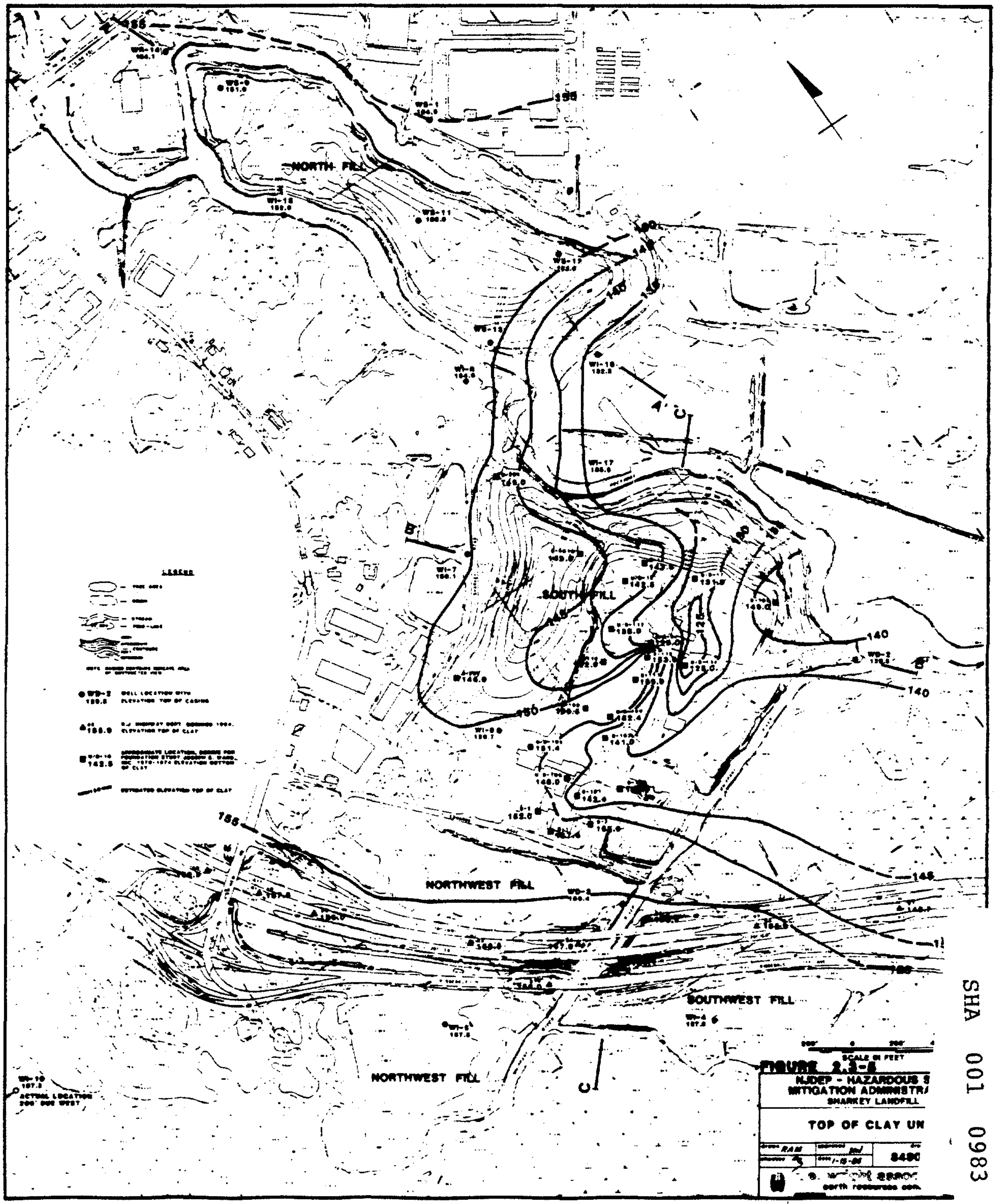
The existence of a relatively thick continuous, mappable, low permeability varved clay unit throughout the site was confirmed by field investigations. The depths at which this unit was encountered are shown on the monitoring well logs included in Appendices B-1 and B-2, and Table 2-1 in Section 2.1.3.

Figures 2.3-4, 2.3-5 and 2.3-6 have been prepared on the basis of the combined results from RI/FS geologic and geophysical investigations, the Ward studies and NJHD data. These figures include a clay isopach or thickness map, and contoured interpretations of the top of the clay unit and the bottom of the clay unit, respectively.

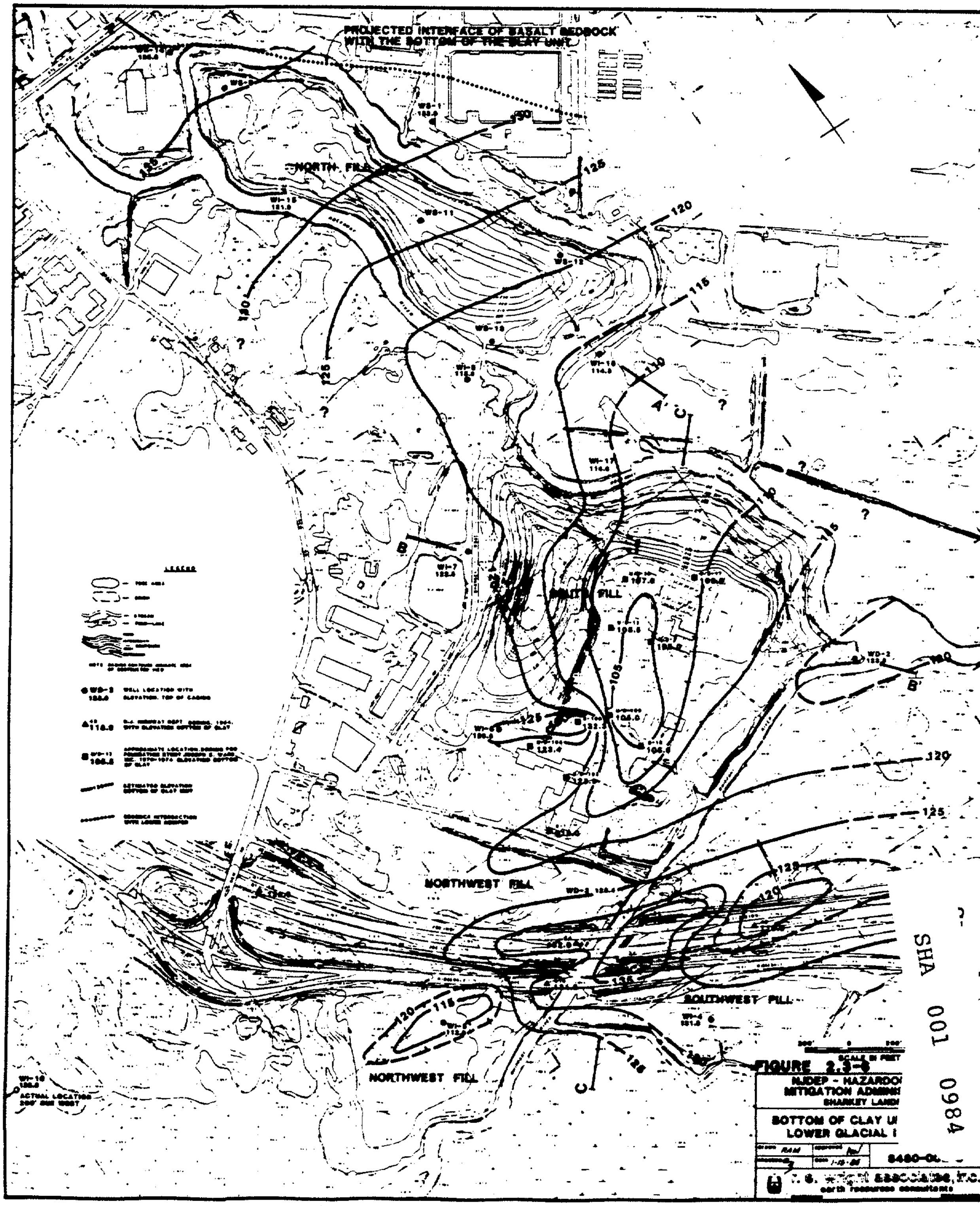
The overall permeability of this gray varved clay unit is about 1.3×10^{-7} cm/sec, or 2.8×10^{-3} gallons per day per square foot gpd/ft^2 (see Section 2.1). As shown on Figure 2.3-4 the minimum


NORTHWEST FILL
NORTHWEST FILL
SOUTHWEST FILL
FIGURE 2.3-4
CLAY ISOPACH
8480-00

SHA 001 0982


NORTH FILL
SOUTH FILL
NORTHWEST FILL
SOUTHWEST FILL
NORTHWEST FILL
LEGEND
SCALE IN FEET
FIGURE 2.3-5
NJDEP - HAZARDOUS S
MITIGATION ADMINISTRA
SHARKEY LANDFILL
TOP OF CLAY UN

SHA 001 0983


PROJECTED INTERFACE OF BASALT BEDROCK WITH THE BOTTOM OF THE CLAY UNIT
NORTH FILL
NORTHWEST FILL
SOUTHWEST FILL
NORTHWEST FILL
FIGURE 2.3-5
NJDEP - HAZARDO
MITIGATION ADMIN
SHARKEY LAND
BOTTOM OF CLAY U
LOWER GLACIAL

SHA 001 0984

thickness of the clay is projected to occur beneath the sewage treatment plant on the South Fill, where it may thin to 15 feet. The average thickness of the unit is about 25 feet.

Review of Figure 2.3-5, showing the top of the clay unit, indicates that a depression is present in the upper surface of this unit traversing the central portion of the sewage treatment plant trending to the northeast. The structure of the top of clay surface in the vicinity of the South Fill appears somewhat complex in comparison to the relatively flat relief projected to the northwest and southwest. This apparent structure is partly due to the relative intensity of data points within the South Fill area. However, NJHD data and geologic logs from Wells WI-4, WI-5 and WI-10 suggest that the overall structure of the clay surface in the area to the southwest of the South Fill is relatively flat. Information obtained in the North Fill area during construction of the RI/FS shallow monitoring wells also suggests that the top of clay surface dips at a gradient of approximately 4% to the South beneath the southern end of the North Fill. The contours suggest that a basin or open swale formed by the clay surface to the south of Site WI-16 and to the north of the South Fill area, may be present.

There are insufficient data points at the northeast margins of the South Fill, adjacent to the Rockaway River and in the area on the opposite side of the river, to determine whether a closed depression, formed by the clay surface exists locally, or whether it is open, and slopes away from the site to the north, east or southeast. The configuration of the clay surface, however, does suggest that contaminant migration in the shallow aquifer near the base of this unit could be controlled by the depression or channel shown beneath the South Fill on Figure 2.3-5. Similarly, contaminants from the North Fill flowing in a

SHA 001 0985

southward direction and eluding Rockaway River discharge, could also be entrapped by the clay depression south of the North Fill. The ultimate destination or direction of migration beyond the contours shown on Figure 2.3-5 cannot be delineated with the data presently available.

Figure 2.3-6 shows the contours of the bottom of the clay unit. There is a depression, or slump, beneath the South Fill at the base of the clay unit reflecting the depression presented in the clay surface, offset however, to the southwest. It is possible that some minor localized rebounding or flexing of sediments occurred in this area after the lake was drained, resulting in the contortions evident in the clay structure.

There are also downward protrusions of the bottom of the clay unit in the vicinity of Route I-28Ø. These depressions are not reflected in the top of the clay unit contours shown on Figure 2.3.5. It should be noted, however, that these depressions are based only on two data points. Also shown on Figure 2.3-6 is the projected interface of the basalt bedrock with the bottom of the clay unit. This interface line appears to roughly parallel the main branch of the Rockaway River, and occurs northeast of the North Fill.

2.3.4 Upper Alluvial Deposits

All natural deposits extending from the top of the varved clay to the ground surface are referred to in this report as upper alluvial deposits. However, this group does not include landfill (fill) deposits.

Assuming an average elevation of natural ground surface of approximately 175 feet, the overall thickness of this unit is approximately 25 feet in most areas to the southwest and northwest of the South Fill area. Assuming that natural grade in the South Fill area prior to landfill development was consistent with adjacent topography, the thickness of this uppermost unit was probably as much as 50 feet in the central portions of the South Fill, based upon the contours presented on Figure 2.3-5.

Landfill excavation through much of the study area has substantially depleted the record of these shallow sediments. However, examination of the Ward and NJHD boring logs indicate that this horizon generally consists of gray and brownish-gray sand, inter-fingered with silt and silty sand deposits across the site. There is a complex arrangement of alluvial structures present within this upper horizon. The lowermost portions of this unit appear to be generally finer, grading downward to the underlying silty varved clay unit. Peat deposits were found intermixed with these fine deposits at Site W-3. The transition to the varved clay, however, is not always gradual; in some areas, such as Sites WI-7, WI-8, WI-15, and WI-16, the transition is a sharp contrast.

2.3.5 Fill Material

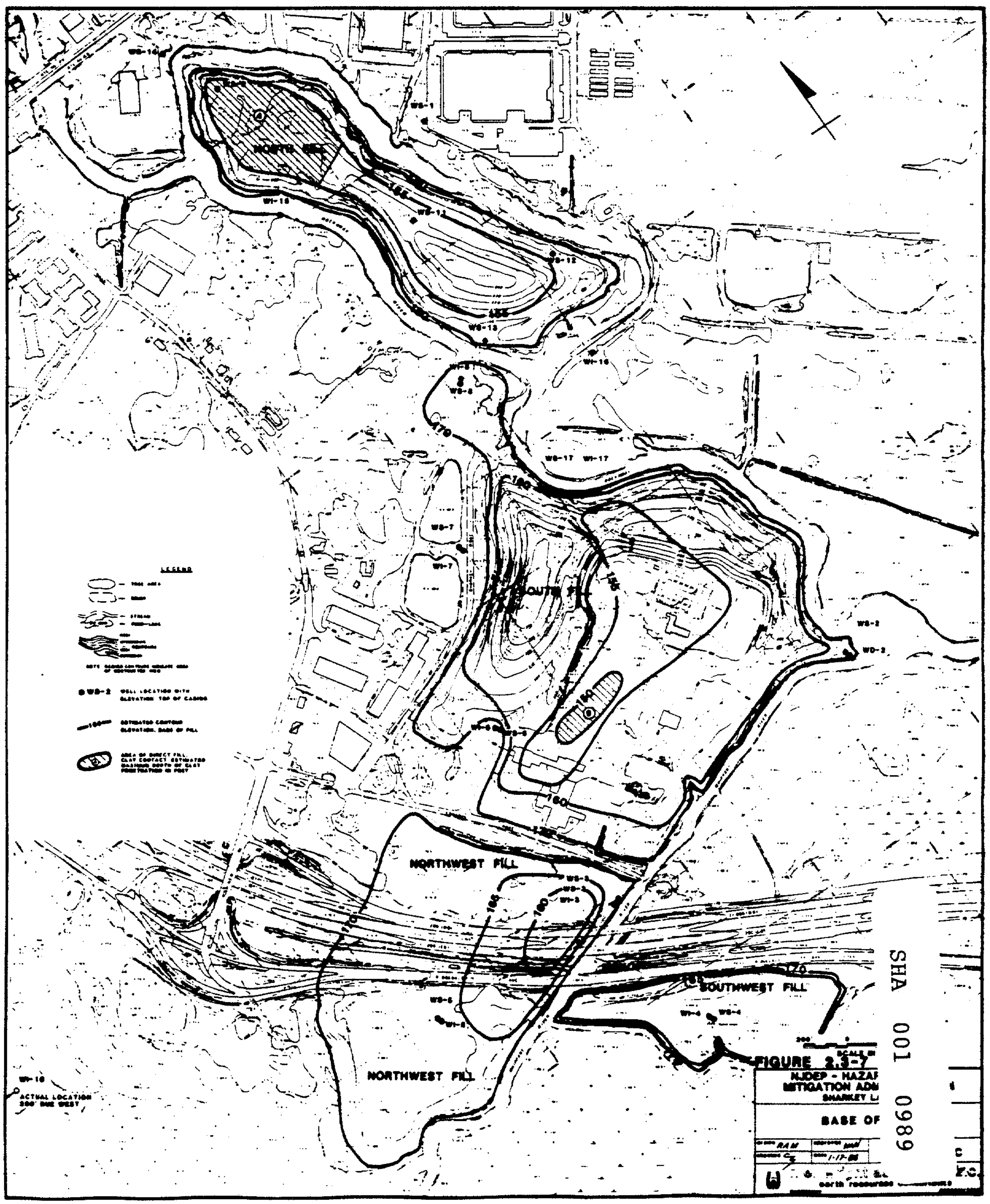
In this discussion, fill consists of garbage and other wastes deposited across the site during original landfilling activities, including material moved or disrupted during the Parsippany-Troy Hills sewage treatment plant expansion, or construction of Route I-280. Cover material placed on or with the waste is also considered as fill material.

Figure 2.3-7 shows the contoured elevations depicting the projected base, or bottom, of the excavation in which the fill material was placed. Due to the limited number of data points available, this figure provides only a general characterization, or interpretation, of the excavations completed and the resultant depth of fill present.

From the base of fill elevations shown, fill thicknesses on the North Fill vary from approximately 85 feet at the south end, to about 45 feet at the north. It should also be noted that the southern half of the the North Fill seems to have a fair amount of soil cover and is supporting substantial vegetative growth on the top and side slopes. The northern half of the North Fill, however, has a very thin soil cover, where present at all, and even though a variety of vegetative growth is present, cracks and material displacement at the top and sides of the fill, particularly along the banks of the Rockaway River, are common.

There appears to be a fair soil cover on most of the abandoned South Fill area. Although there are many openings through this cover to the garbage, a vegetative cover appears to be prospering in most areas. The northwestern face of the South Fill, however, is subjected to erosion by the Rockaway River. Exposed wastes at and near the river level are common.

The Northwest Fill section to the northeast of Route I-280 appears to be fairly well vegetated with a thin but substantial soil cover. Much of this area is marshy with reed growth. The Northwest Fill on the southwest side of Route I-280 is sparsely covered and wastes are exposed at the surface throughout much of the area. Smoldering wastes have also been reported in this


NORTH
SOUTH
NORTHWEST FILL
SOUTHWEST FILL
NORTHWEST FILL
LEGEND
ACTUAL LOCATION 300' DUE WEST
WS-17 WI-17
WS-7
WI-7
WS-2
WD-2
WS-4
WS-6
WI-16
170
180
160
150
FIGURE 2.3-7
NJDEP - HAZA
MITIGATION ADM
SHARKEY L
BASE OF
earth resources

SHA 001 0989

area. The Southwest Fill area has a substantial cover and is supporting rather dense plant growth.

The gray varved clay unit was apparently encountered during excavation and fill placement operations on the North and South Fill areas, as projected on Figure 2.3-7. Overall depths of clay penetration by landfilling operations where indicated appear to be between 0 and 5 feet. There is no evidence that complete penetration of the clay unit has taken place anywhere beneath the site. The clay isopach map (Figure 2.3-4) reflects the residual thickness of the clay, following landfilling activities.

2.4 Aquifer Testing

2.4.1 Groundwater Level Monitoring

Periodic monitoring of water levels by manual measurement in all of the RI/FS monitoring wells was performed between August 23, 1985, and January 2, 1986. Staff gages were also installed on the Rockaway and Whippany Rivers and on each of the two ponds adjacent to Monitoring Well Site WI-7. Surveyed elevations on the staff gages were used to obtain surface water elevations at each station. Table 2-4A provides a summary of the periodic monitoring data for each location.

Continuous monitoring of water levels in Wells WI-3, WI-8, WD-2, WS-3 and WS-8 was performed using Stevens water level recorders. Copies of recorder charts associated with this continuous monitoring, conducted between November 26, 1985 and January 2, 1986, are provided in Appendix B-8.

2.4.1.1 Shallow Aquifer - The results of water level monitorin(on two selected dates have been contoured to reflect th groundwater levels observed in both the shallow (upper) an(

SHA 001 0990

Table 2-4A

Sharkey Landfill - Water Level Data
August 1985 - January 1986

Date/Water Level Elevation (ft. msl.)

LOCATION	08/15/85	08/30/85	09/13/85	09/20/85	10/09/85	10/15/85	10/29/85	11/12/85	12/04/85	12/10/85	12/16/85	12/20/85	01/02/86
WS-1							165.63			167.89	167.72	171.01	166.01
WS-2	163.33	167.39	163.36	163.50	165.81	163.50	163.50	163.64	168.33	166.13	165.48	164.25	163.88
WD-2	165.19	164.94	165.03	165.49	166.47	166.54	166.37	166.49	168.13	167.71	167.77	167.69	167.53
WI-3			152.63	166.52	165.40	166.66	166.64	166.81	168.25	168.20	167.87	167.80	167.70
WS-3		160.16	160.11	160.33	160.36	160.36	159.97	160.08	160.49	160.27	160.24	160.05	159.98
WD-3		161.43	159.52	166.57	165.46	167.3	165.59	167.41	168.07	167.77	167.99	167.99	167.82
WI-4							166.58	166.77	168.08		167.68	167.55	167.38
WS-4							165.15	165.36	168.60		166.12	165.53	165.14
WI-5					155.12	167.59	167.27	166.96	168.10	168.07	168.27	168.17	167.97
WS-5					169.22	169.46	168.67	168.82	170.20	169.97	169.72	169.42	168.87
WI-6	163.16		164.94	166.46	166.97	167.08	166.70	166.76	168.85	169.21	168.31	168.04	167.71
WS-6	167.81		166.70	167.21	167.60	168.43	167.59	167.58	169.30	169.43	168.83	169.51	168.73
WI-7			159.64	165.21	159.18	166.18	165.92	166.06	167.59	174.33	167.48	167.21	167.05
WS-7				169.30	166.74	169.84	169.55	169.55	171.14	177.32	171.07	170.92	170.72
WI-8				165.86	166.78	166.99	166.95	166.99	168.37	168.10	168.10	167.94	167.85
WS-8					168.30	164.87	164.89	164.89	169.18	167.18	165.81	165.72	165.17
WS-9					170.54	176.15	166.55	169.50	173.29	173.50	172.81	172.25	169.95
WI-10							167.14	167.29	168.05	167.93	168.08	167.93	167.78
WS-11						166.19	167.49	163.91	169.01	168.84	166.69	167.19	164.86
WS-12					168.52	167.73	164.88	165.71	169.38	167.23	166.83	166.03	165.73
WS-13					165.77	164.51	164.51		169.04	166.73	166.68	165.23	164.83
WS-14						164.97	164.84		169.21	167.16	166.76	165.61	165.11
WI-15							167.85	166.92	168.49		168.11		167.93
WI-16						166.68	166.51	166.68	168.27	167.94	168.06	167.89	167.84
WI-17					163.05	163.86	166.68	166.62	168.30	167.91	167.91	168.03	167.71
WS-17					166.12	164.35	165.89	164.32	168.85	166.60	166.27	169.17	166.10
Edwards Rd. Bridge						165.56					165.46	164.66	164.36
N. Pond				168.77	169.61	169.65			170.81		166.38	170.11	169.96
S. Pond				168.55	168.48	168.5			169.30		169.42	170.25	170.04
N. Fill Brg.				164.48	165.83	164.48					166.83	165.33	
Rockaway											166.76		

SHA 001 0991

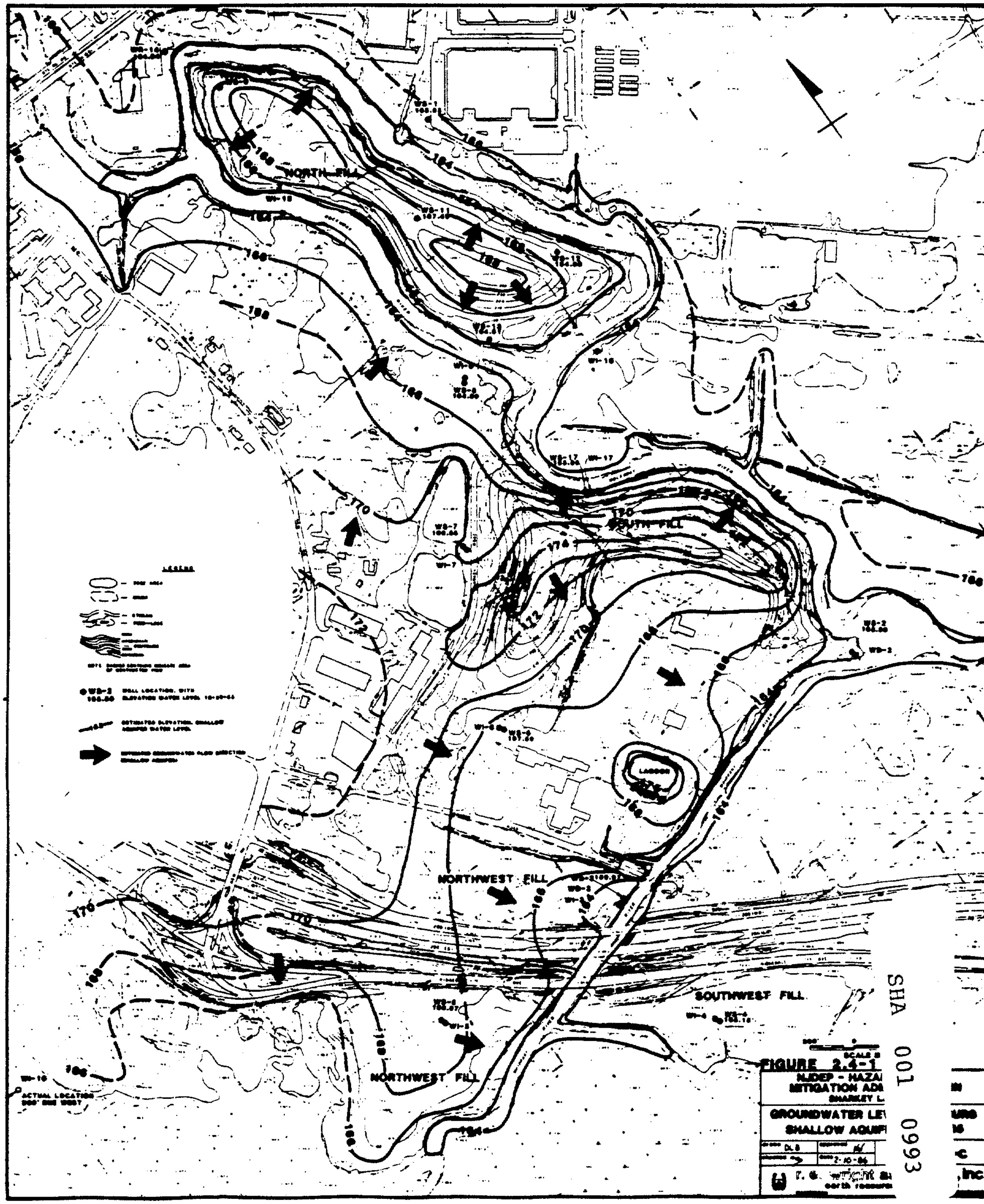
lower aquifers. Figure 2.4-1 and 2.4-2 show the shallow aquifer water level contours on October 29 and December 16, 1985.

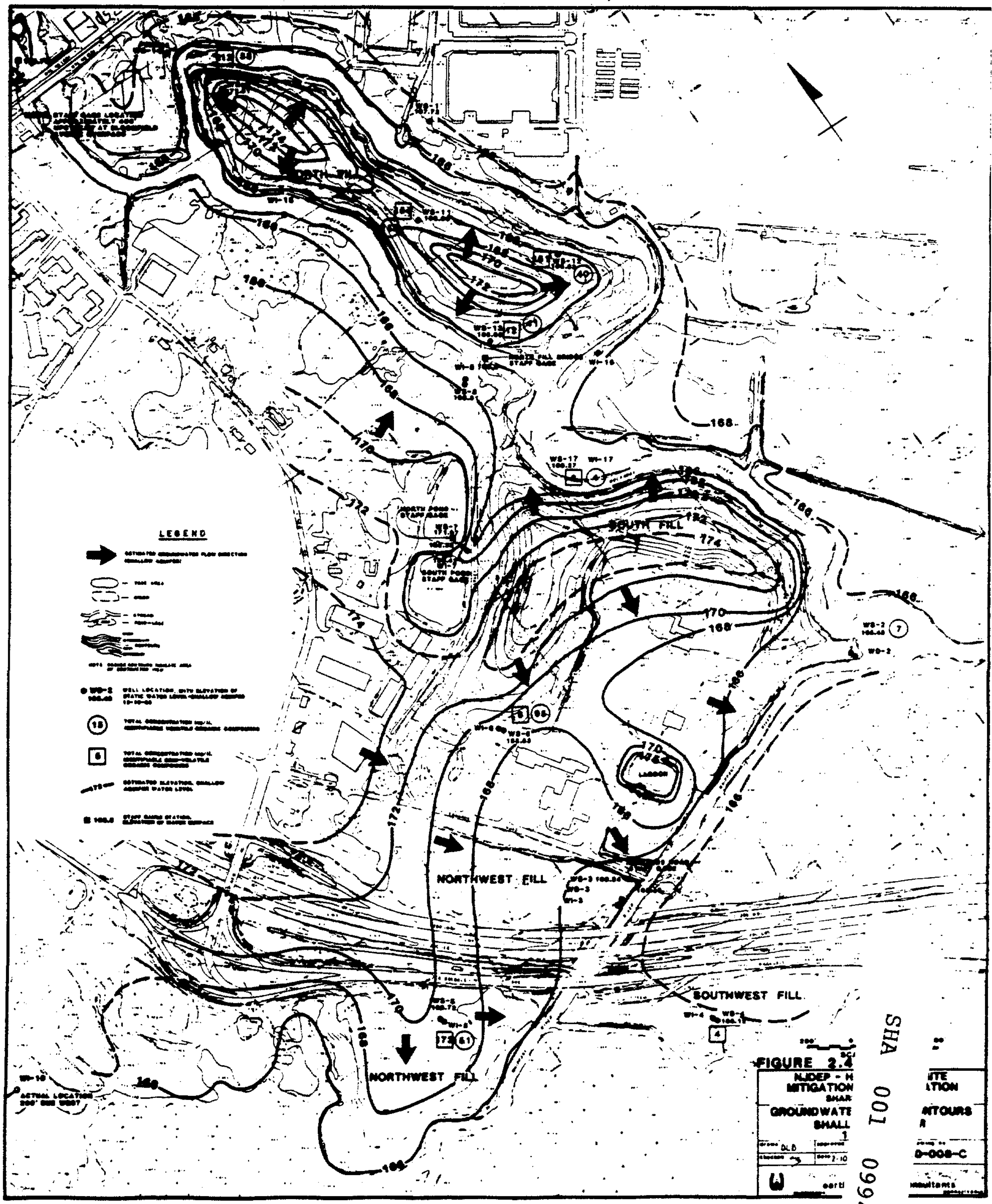
The data indicates water table conditions are present in both the upper alluvial deposits and in fill material. The term "shallow aquifer" will be used to indicate groundwater flow within either or both of these horizons.

Groundwater mounding is evident on the North Fill and the South Fill, within topographically pronounced fill deposits. No monitoring wells or borings were constructed on top of the thick fill areas in the South Fill for this RI/FS, to indicate specific water level data for those areas. However, the Ward data indicates that groundwater was encountered in the fill area northeast of the Sewage Treatment Plant (STP) at a maximum elevation of 176 feet near the top of the fill.

The lagoon near the southeastern corner of the STP, appears to affect the shallow aquifer water table by allowing infiltration of process water, shown by the inferred contours on Figures 2.4-1 and 2.4-2, producing a steep mounding of the shallow aquifer water table near the lagoon. Evidence of this mounding effect can be seen as a repetitious fluctuation of water levels at Well WS-3 (Figure 2.4-3). The data suggests that lagoon area mounding may influence the shallow aquifer water table levels (and localized flow) throughout the southern portion of the South Fill and the northeastern portion of the Northwest Fill.

It should be noted, however, that anomalous water level data was obtained at Well WS-3. The water levels in this well were consistently lower than water levels observed in Well WS-2, located downstream, near the confluence of the Whippany and Rockaway Rivers. The water level elevation in Well WS-3 is also


NORTH FILL
SOUTH FILL
NORTHWEST FILL
SOUTHWEST FILL
LEGEND
ACTUAL LOCATION
FIGURE 2.4-1
NJDEP -
MITIGATION
GROUNDWATER
SHALLOW
170
166
168
164
172
174


LEGEND
NORTH FILL
SOUTH FILL
NORTHWEST FILL
SOUTHWEST FILL
LAGOON
FIGURE 2.4
NJDEP - H
MITIGATION
GROUNDWATE
SHALL

SHA 001 0994

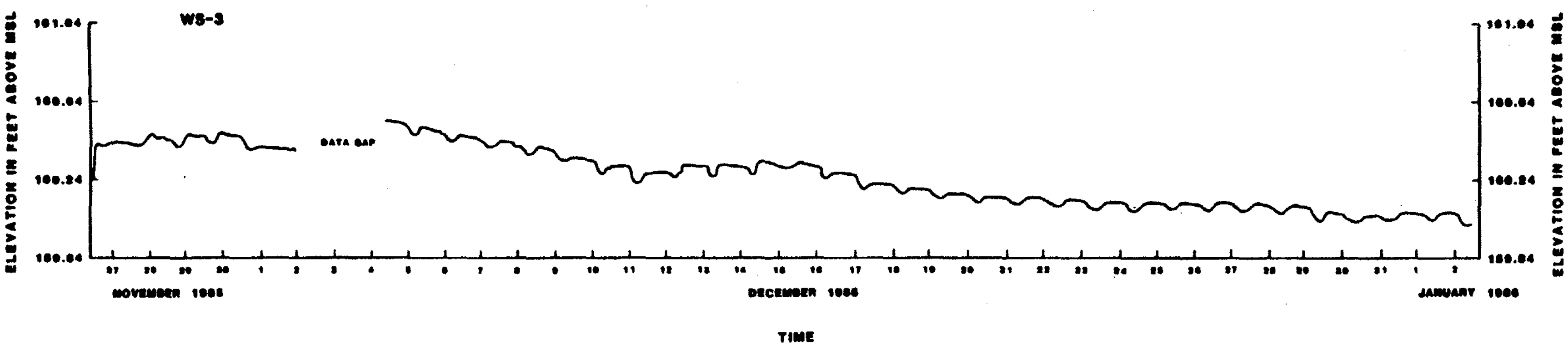


FIGURE 2.4-3

NJDEP - HAZARDOUS SITE MITIGATION ADMINISTRATION
SHARKEY LANDFILL

GROUNDWATER LEVEL MONITORING DATA
WELL WS-3

drawn RAM | approved [illegible] | checked [illegible] | date 1-27-86 | drawing no. 8480-014-B

r. e. wright associates, inc.
earth resources consultants
middletown pennsylvania

lower than the elevation of the adjacent Whippany River, reflected by the Edwards Road Bridge staff gage measurements (Table 2-4). The differences in elevation between the water level in WS-3 and the Whippany River is approximately 5.2 feet on October 15, 1985, declining gradually to a difference of 4.4 feet on January 2, 1986.

It is possible that a localized gravel or highly permeable deposit is present beneath Site WS-3 that is not in hydraulic communication with the Whippany River channel. The anomalously high permeability could cause an anomalous drawdown effect. There is evidence of a sand horizon with a small gravel lens above the clay unit in the logs of Wells WS-3 (Appendix B-1). This is, however, a highly improbable mechanism and would require a set of very unique subsurface conditions. The anomalous measurement could also be a result of well screen clogging, preventing adequate hydraulic communication inside the well. However, the well does appear responsive to external conditions evidenced by Figure 2.4-3. Furthermore, if poor hydraulic connections within the well were the cause of continuously anomalous levels, it does not follow that the observed levels in the well would be consistently lower than the adjacent aquifer.

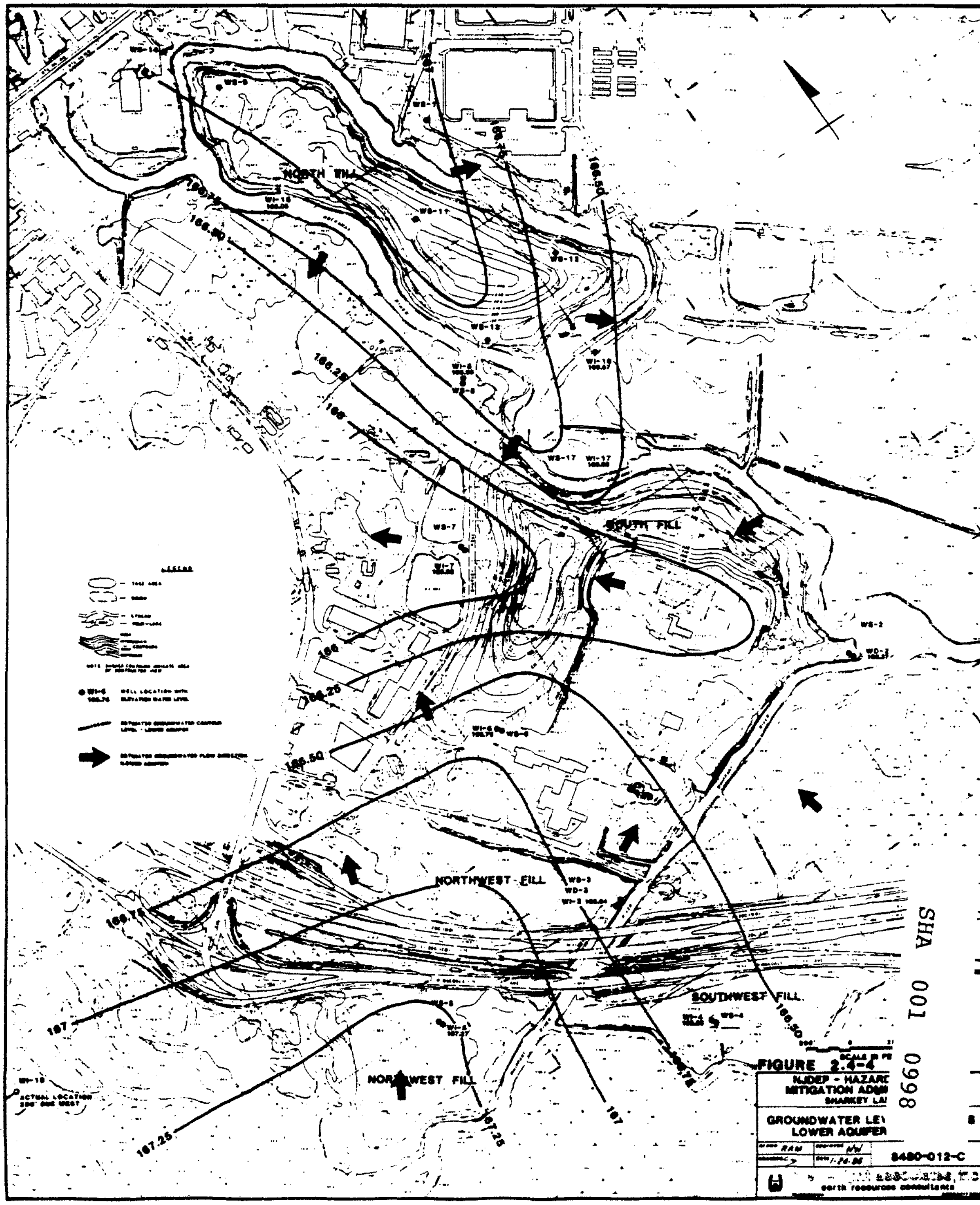
It is also possible that an error was made in the reported elevation of the top of casing at Well WS-3. Wells WS-3, WI-3 and WD-3, shown on Table 2-1, indicate comparable elevations for each of these three adjacent wells. VEP Engineers and Surveyors, Inc., have checked the field data to validate the reported elevations. The survey closure is reportedly within acceptable error limits. Furthermore, an error of four to five feet should be visibly apparent.

The shallow aquifer water levels at Site WS-3 remain anomalous. The directional extent and magnitude of the anomaly, if present, would be entirely speculative, and should not be considered factual unless and until confirmed by additional data points. Therefore, the contours shown on Figure 2.4-1 and 2.4-2 do not reflect a localized drawdown of the aquifer at Well WS-3.

2.4.1.2 Lower Aquifer - Contour maps of the piezometric surface on October 26 and December 16, 1985 of the lower glacial outwash aquifer are shown on Figures 2.4-4 and 2.4-5.

The water level data obtained from the intermediate wells suggests that the flow system for this lower aquifer is not in unison with the shallow aquifer, in terms of flow direction, reflected by the slope of the piezometric surface contour. The flow pattern in the lower aquifer appears to diverge to the northwest and southeast from the vicinity of the Sewage Treatment Plant. The northwest vector was not observed or suggested in the shallow aquifer contour maps (Figures 2.4-1 and 2.4-2), where most flow from the South Fill area appears to migrate toward the south and the Whippany River.

It should be noted however, that the overall piezometric relief of the lower aquifer is very flat, ranging in observed elevations across the site from 166 feet to 167.25 feet on October 29; and 167.25 feet to 168.25 feet on December 16. At most, a variation of 1.25 feet is present across the site. Even minor localized fluctuation of these observed levels could significantly alter the interpretation of the flow system. The piezometric surface shown should be viewed with this realization.


NORTH FILL
SOUTH FILL
NORTHWEST FILL
SOUTHWEST FILL
NORTHWEST FILL
166.75
166.50
166.25
166
166
166.25
166.50
166.75
167
167.25
167.25
167
166.75
166.50
166.50
FIGURE 2.4-4
SHARKEY LA
GROUNDWATER LE
LOWER AQUIFER
8480-012-C
earth resources consultants

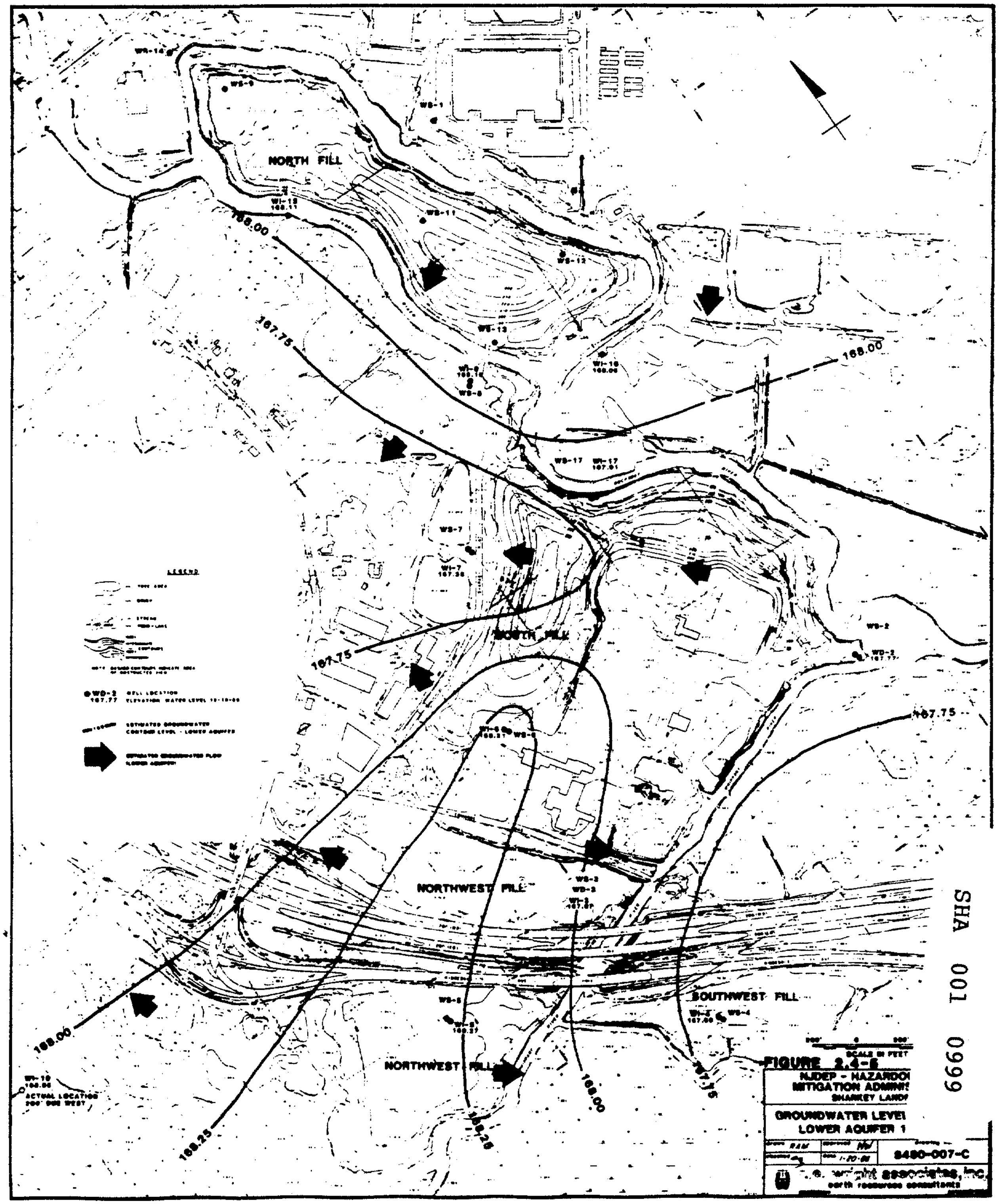
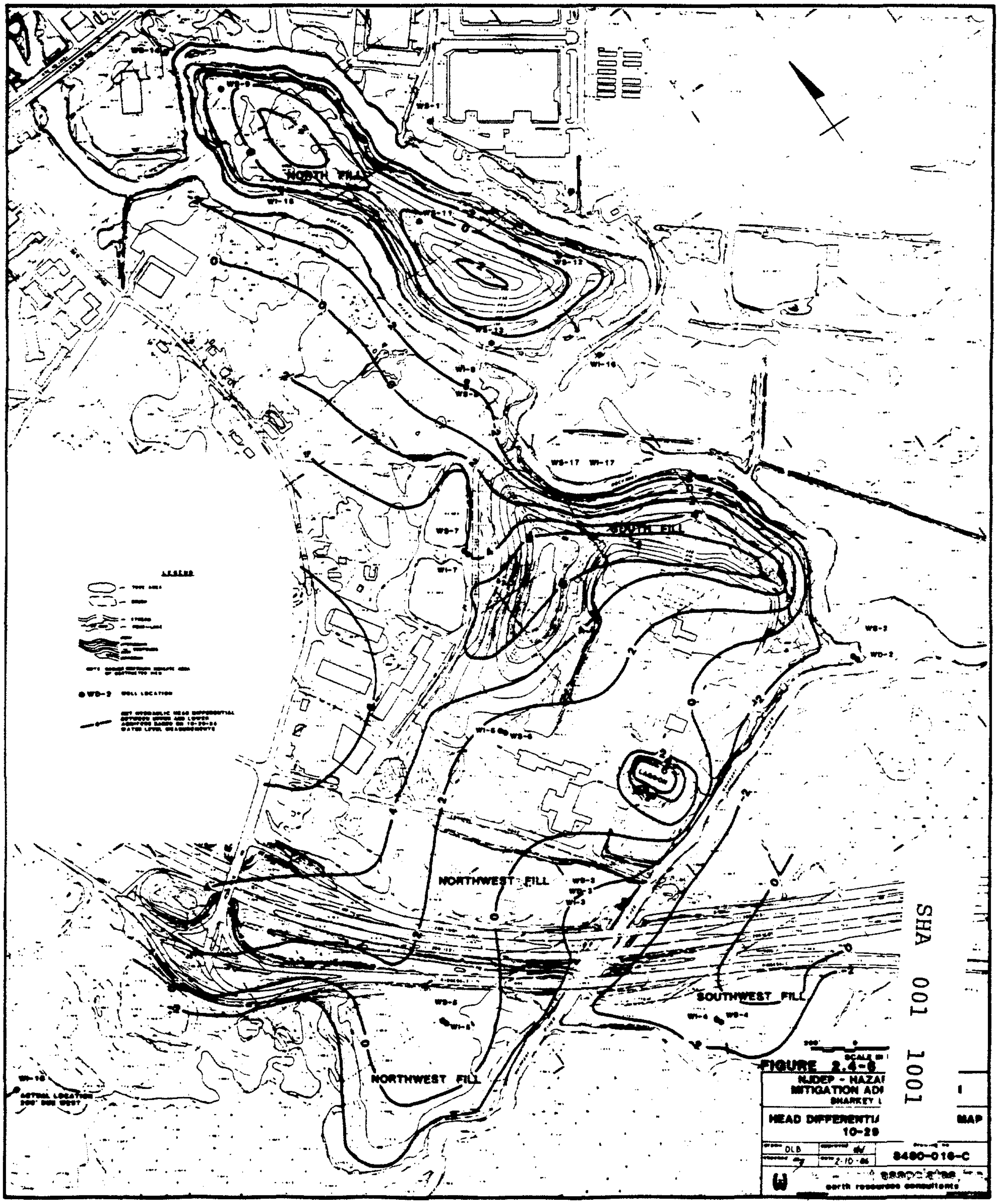

NORTH FILL
NORTH FILL
NORTHWEST FILL
NORTHWEST FILL
SOUTHWEST FILL
168.00
167.75
168.00
167.75
167.75
168.00
168.25
168.25
168.00
167.75
WS-17
WI-17
WS-7
WI-7
WS-2
WD-2
LEGEND
FIGURE 2.4-5
NJDEP - HAZARDO
MITIGATION ADMINI
SHARKEY LAND
GROUNDWATER LEVE
LOWER AQUIFER 1
8480-007-C
earth resources consultants

Figure 2.4-6 shows the hydraulic head differential between the lower and shallow aquifers. Positive contour values indicate that the shallow aquifer has net downward hydraulic pressure; a negative value indicates the reverse. This map is derived from the October 29, 1985 water level data presented on Figures 2.4-1 and 2.4-4. The net head potentials shown are controlled predominantly by the water levels observed in the shallow aquifer since the gradient of the Lower Glacial outwash aquifer is relatively flat. Furthermore, there are no lower aquifer monitoring points on the North Fill. Therefore, the relationship in this area is inferred. The data suggests that the difference in head potential is greatest in areas paralleling the rivers, where the river's influence on shallow aquifer water levels dominates.

2.4.1.3 Continuous Water Level Monitoring Data - Continuous groundwater monitoring stations were set up on five monitoring wells for a period of five weeks. The wells selected for monitoring were WI-8, WI-3, WD-2, WS-8, and WS-3. Individual monitoring charts for each of these stations are located in Appendix B-8. This data has been used (as needed) in the overall site hydrogeologic evaluations.

2.4.1.4 Flow Direction Testing - Flow direction testing using a K-V flowmeter, as proposed in the FSP, was not performed. At the suggestion and approval of the NJDEP, additional manual water level measurements were obtained across the site in lieu of the flow direction testing. The additional water level monitoring data is included on Table 2-4.


NORTH FILL
SOUTH FILL
NORTHWEST FILL
SOUTHWEST FILL
NORTHWEST FILL
FIGURE 2.4-6
MAP
8480-016-C
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SHA 001 1001

2.4.2 Slug Tests - Shallow Aquifer

Slug tests were conducted on six shallow monitoring wells to approximate the horizontal hydraulic conductivity of the shallow aquifer. The slug tests were conducted in accordance with the FSP specifications. At least four individual tests were conducted on each of the six wells.

Appendix B-7 contains a summary of data and results for each test, including permeability calculations associated with the wells tested. The screened intervals of Monitoring Wells WS-2, WS-6, WS-7, and WS-13 are predominantly or entirely within the upper alluvial aquifer. Wells WS-9 and WS-17 were screened in fill material. Table 2-5 summarizes the average permeabilities of the shallow aquifer as determined by these tests. As shown, the upper aquifer in the vicinity of Monitoring Well WS-13 on the southern end of the North Fill has the highest permeability of the wells tested; Well WS-7, to the west of the South Fill has the lowest. The results of tests at Wells WS-2 and WS-6 estimate the permeability of the upper alluvial aquifer at the eastern and southern borders of the South fill.

2.4.3 Pumping Tests - Lower Aquifer

2.4.3.1 Purpose/Scope - Two pumping tests were performed during this RI/FS. These tests were conducted on the lower glacia outwash aquifer, utilizing Wells WI-8 and WI-3. The purpose oi these tests was to measure hydraulic parameters anc configurations of the lower aquifer materials, including:

Table 2-5

Slug Test Permeability Results For The
Shallow Water Table Aquifer
Sharkey Landfill

Well	Screened Material	Average Permeability cm/s	ft/d	gpd/ft^2
WS-2	Medium To Coarse Sand And Gravel	4.2×10^{-3}	12.0	90.0
WS-6	Medium To Coarse Sand And Gravel	6.2×10^{-4}	1.8	13.1
WS-7	Fine To Coarse Sand And Gravel	1.6×10^{-4}	0.4	3.4
WS-9	Refuse	5.2×10^{-3}	14.8	111
WS-13	Fine To Coarse Sand	1.1×10^{-2}	32.5	243
WS-17	Refuse	4.8×10^{-3}	13.5	100

SHA 001 1003

1. Aquifer Transmissivity (T) - the ability of the aquifer to conduct groundwater flow at a unit hydraulic gradient through a specified cross sectional area of the aquifer.

2. Aquifer Storativity (S) - volume of water that an aquifer releases per unit surface area per unit change in the component of the hydraulic head normal to that surface;

3. Presence of hydraulic barriers, boundaries, or changes in aquifer materials; and

4. Vertical leakage through the confining varved clay unit.

The scope of the pumping tests as planned in the FSP was to consist of three 24-hour pumping tests of the lower aquifer. The wells to be tested included WD-2, WI-3, and WI-8. However, the test on WI-8 was prolonged to a duration of 48-hours to maximize the value of data obtained during that test. In view of limited observation points around Well WD-2, the test on WD-2 was cancelled, with NJDEP approval.

2.4.3.2 Testing Methods - Each test was begun with a short step-drawdown test. Initial pumping rates were increased over selected time increments to establish a maintainable groundwater yield from the pumping well, and maximize stress on the aquifer through the test duration. In each case, the selected test pumping rate was established in two pumping rate steps within one hour after the start of the test, and held constant throughout the remainder of the test.

Continuous water level recorders were installed on surrounding monitoring wells prior to pumping to establish pre-test groundwater level conditions. Water level monitoring was continued during pumping to record the effect of pumping on the aquifer water levels. Manual water level measurements were performed frequently in the wells during the initial portion of the tests, and less frequently as each test progressed. Following completion of the pumping phase of each test, recovery of water levels in the pumping and observation wells was observed until static or stabilized conditions were achieved.

2.4.3.3 Analysis Methods - Pumping tests have been analyzed using the Jacob Method (Fetter, 1980) for determination of aquifer transmissivity and storativity. The Jacob Method consists of semi-logarithmic plotting of the water level drawdown (d) versus the corresponding time (t) in minutes, since pumping started. The slope of a straight line through the drawdown curve per log cycle is expressed as Δs. The transmissivity of the aquifer is then determined by the equation:

$$T = \frac{264Q}{\Delta s} \qquad (1)$$

where:

T = Aquifer transmissivity in gallons per day per foot (gpd/ft)
Q = Groundwater discharge rate in gallons per minute (gpm)
Δs = Slope of best fit line over one log cycle (dimensionless).

The storativity of the aquifer can be estimated by:

$$S = \frac{Tt_o}{4790r^2} \qquad (2)$$

where:

T = Aquifer transmissivity (gpd/ft)
S = Aquifer storativity (dimensionless)

t_o = Time intercept at d=0 of time drawdown curve (minutes)
r = Distance from monitoring well to pumping well (ft)

Distance-drawdown plots using multiple observation well responses to obtain a drawdown versus distance graph at a given point in time (t), were also included in the analyses to compare or validate the transmissivity (T) and storativity (S) values determined by the time-drawdown data. Using this technique:

$$T = \frac{5280}{\Delta s} \qquad (3)$$

where:

T = Aquifer transmissivity (gpd/ft)
Q = Groundwater discharge rate (gpm)
Δs = Best fit line slope over one log cycle (dimensionless)

and:

$$S = \frac{Tt}{4790 r_o^2} \qquad (4)$$

where:

S = Aquifer storativity (dimensionless)
T = Aquifer transmissivity (gpd/ft)
t = Time (minutes)
r_o = Distance of zero drawdown intercept (ft) from pumping well

After pumping was terminated, aquifer water level recovery (residual drawdown) was also analyzed as a check on calculated aquifer transmissivity values. For each of the piezometers

SHA 001 1006

monitored, a logarithmic graph was generated by plotting the residual drawdown versus the ratio of time (in minutes) since pumping began (t) divided by the time since pumping was terminated (t'). A slope of a best fit line fitted through the recovery curve was used to determine aquifer transmissivity as described in equation (1). Aquifer storativity cannot be calculated using this analytical method.

2.4.3.4 Pumping Test At Well WI-8 - Water level recorders were installed at Wells WI-8, WI-7, WI-17, WI-16, WI-15 and WI-6 on November 11, 1985, in preparation for the pumping test at Well WI-8. Pre-pumping water levels stabilized to within Ø.Ø1 foot of fluctuation in the 24 hours before the test. No rainfall had occurred for at least five days prior to the test.

On November 12, the pumping test at WI-8 began. A pumping rate of 2Ø gallons per minute (gpm) was maintained for one hour and stepped to 3Ø gpm for the duration of the pumping test. The specific capacity of WI-8 was calculated at Ø.9 gpm/ft. Figure 2.4-7 displays the drawdown and recovery plots of Well WI-8. This figure clearly shows the drawdown step resulting from the pumping rate increases from 2Ø to 3Ø gpm. The transmissivity for WI-8, estimated at 3,6ØØ gpd/ft, was calculated from the 3Ø gpm portion of the curve.

Figure 2.4-8 displays the time-drawdown plot of observation wells that were monitored and affected during the pumping test Drawdown effects were observed at the nearest observation wel (WI-7), 811 feet to the southwest, in just over 1Ø minutes. Effects of pumping were observed at Well WD-2 at a distance of about 2,2ØØ feet within 9Ø minutes. Time-drawdown response at Wells WI-7, WI-16 and WI-17 provided comparable transmissivity values at varying distances from the pumping center. WD-2 and

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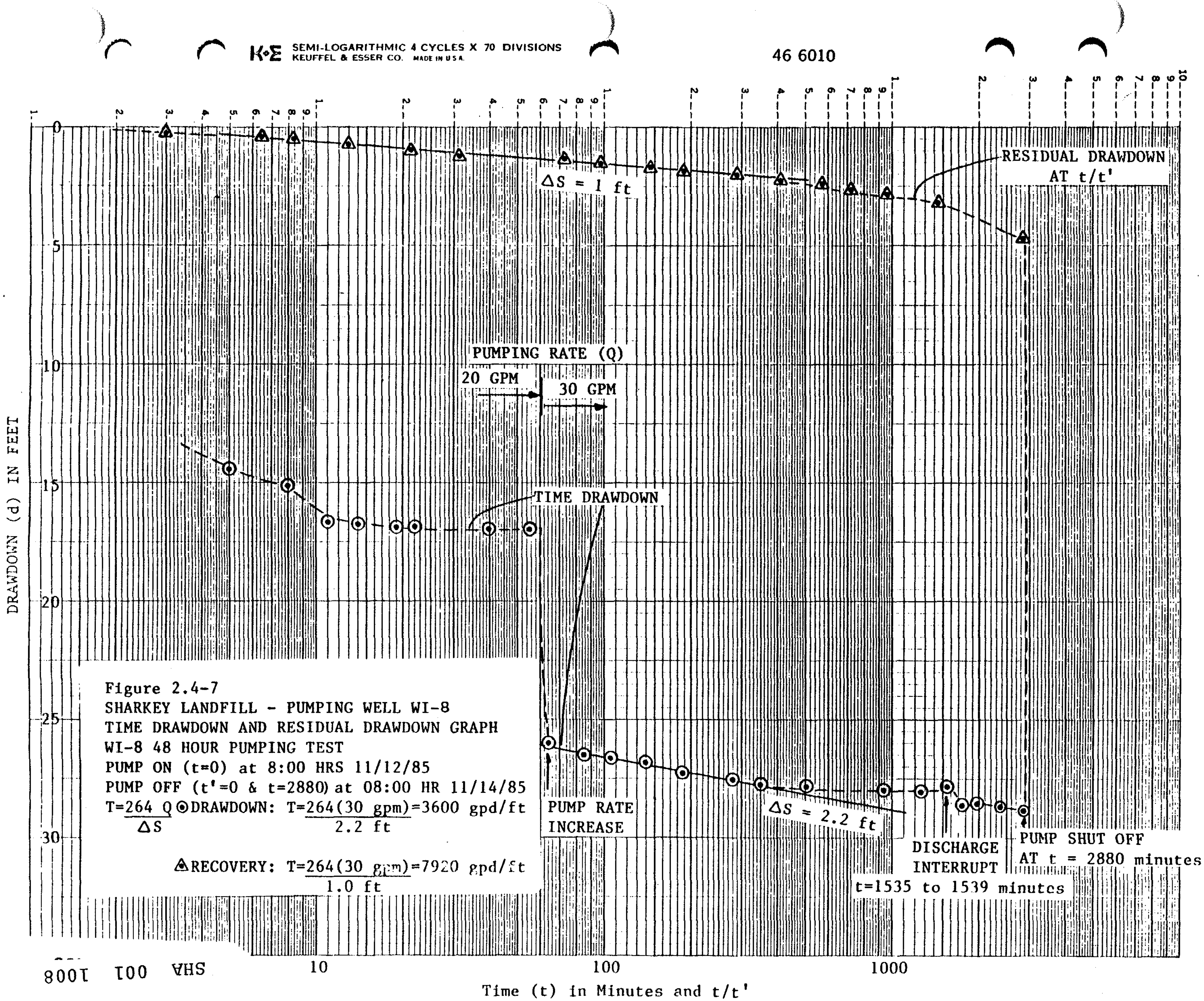
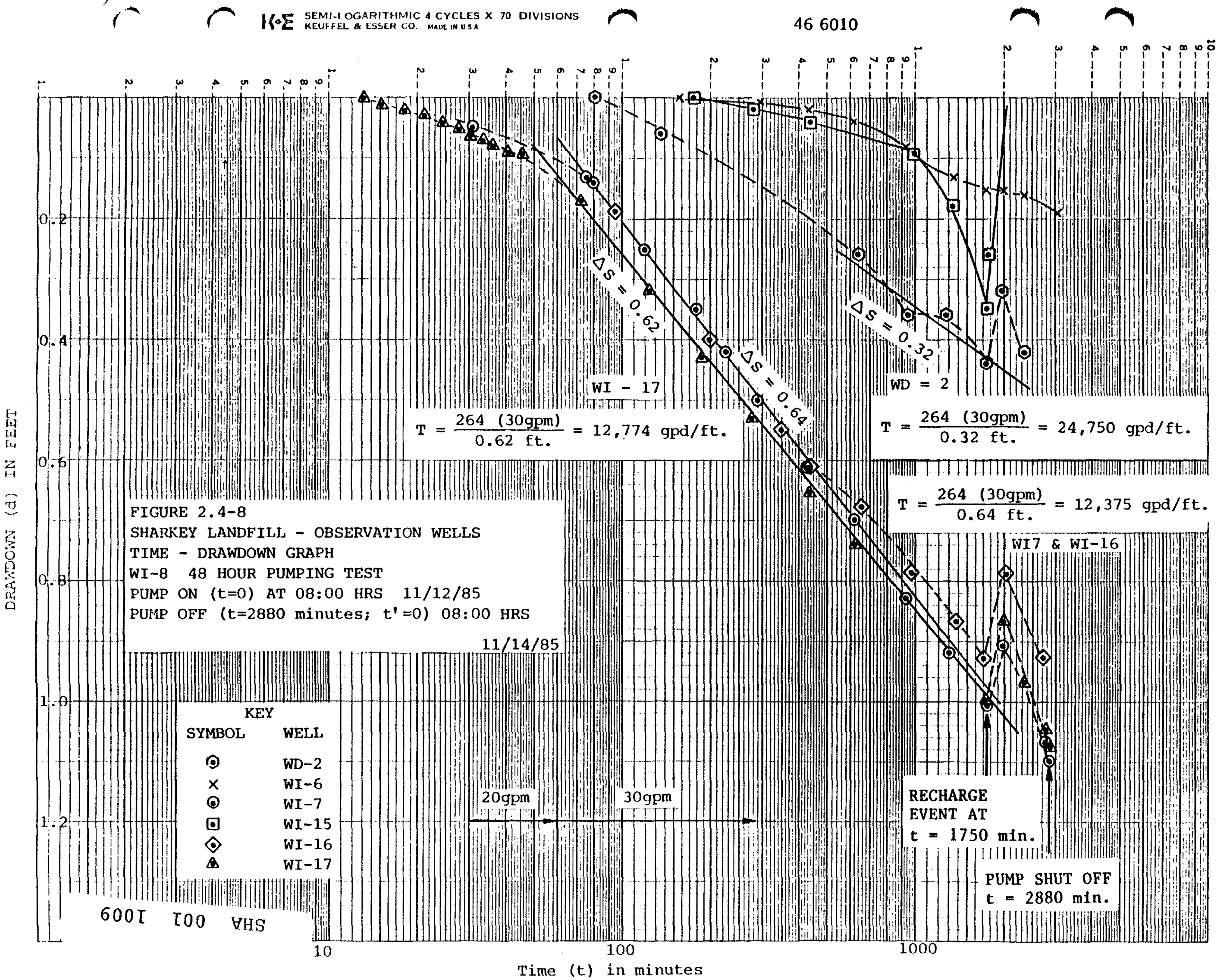


Figure 2.4-7
SHARKEY LANDFILL - PUMPING WELL WI-8
TIME DRAWDOWN AND RESIDUAL DRAWDOWN GRAPH
WI-8 48 HOUR PUMPING TEST
PUMP ON (t=0) at 8:00 HRS 11/12/85
PUMP OFF (t'=0 & t=2880) at 08:00 HR 11/14/85

$T = \frac{264\,Q}{\Delta S}$ ⊙ DRAWDOWN: $T = \frac{264(30\text{ gpm})}{2.2\text{ ft}} = 3600$ gpd/ft

△ RECOVERY: $T = \frac{264(30\text{ gpm})}{1.0\text{ ft}} = 7920$ gpd/ft



K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6010
DRAWDOWN (d) IN FEET
0.2
0.4
0.6
0.8
1.0
1.2
10
100
1000
Time (t) in minutes
$\Delta s = 0.62$
$\Delta s = 0.64$
$\Delta s = 0.32$
WI - 17
WD = 2
T = 264 (30gpm) / 0.62 ft. = 12,774 gpd/ft.
T = 264 (30gpm) / 0.32 ft. = 24,750 gpd/ft.
T = 264 (30gpm) / 0.64 ft. = 12,375 gpd/ft.
WI7 & WI-16
FIGURE 2.4-8
SHARKEY LANDFILL - OBSERVATION WELLS
TIME - DRAWDOWN GRAPH
WI-8 48 HOUR PUMPING TEST
PUMP ON (t=0) AT 08:00 HRS 11/12/85
PUMP OFF (t=2880 minutes; t'=0) 08:00 HRS
11/14/85
KEY
SYMBOL WELL
WD-2
WI-6
WI-7
WI-15
WI-16
WI-17
20gpm
30gpm
RECHARGE
EVENT AT
t = 1750 min.
PUMP SHUT OFF
t = 2880 min.
SHA 001 1009

WI-6 had comparative transmissivity values, although greater than those determined for WI-7, WI-16 and WI-17. Aquifer transmissivities and storativities determined from the pumping test data and the respective analytical methods previously discussed are provided on Table 2-6. A reasonably reliable transmissivity estimate for Well WI-15 could not be calculated using this method, due to the indeterminate slope of the drawdown curve.

The drawdown rate at Observation Well WI-15 increased markedly after 800 minutes of pumping, as shown on Figure 2.4-8. This suggests that a hydrologic discharge (negative) barrier in the lower aquifer was encountered by the expanding cone of pumping influence. The lower glacial outwash aquifer becomes very thin to nonexistent in the vicinity of Wells WI-15, WS-14, WS-1 and presumably to the immediate northeast of the North Fill. In this area the bottom of the varved clay unit is in close contact with the bedrock surface sloping upward from southwest to northwest. The thinning of the lower aquifer in this vicinity restricts its ability to transmit groundwater in response to sustained pumping of WI-8.

During the pumping test, 0.43 inches of rainfall occurred. No direct recharge of the confined lower aquifer was observed as a result of this precipitation. At 1750 minutes after pumping started however, a sudden marked increase in water level was observed in all observation wells in the lower aquifer in the vicinity of the Rockaway River (Figure 2.4-8). This reaction was coincident with a release of water from the Boonton Reservoir upstream reaching the site, resulting in a rapid increase in the Rockaway River stage at the landfill. The increase of the piezometric water level in the aquifer, as measured in the

TABLE 2-6

HYDRAULIC PARAMETERS OF THE LOWER AQUIFER
DETERMINED FROM PUMPING TESTS
AT WELLS WI-8 AND WI-3

Pumping Well	Monitoring Well	Analytical Method: Time - T(gpd/ft)	Drawdown S	Distance - T(gpd/ft)	Drawdown S	Recovery T(gpd/ft)	Estimated Aquifer Thickness (feet)
WI-8	WD-2	24,750	1×10^{-4}	13,774	2×10^{-4}	24,750	19.6
	WI-6	28,285	1.0×10^{-3}	12,472	2×10^{-3}	22,000	~ 100
	WI-7	12,375	2×10^{-4}	13,774	2×10^{-4}	13,200	~ 80
	WI-8	3,600	--	--	--	7,920	~ 35
	WI-15	--	--	12,472	2×10^{-3}	--	12
	WI-16	12,375	3×10^{-4}	13,774	2×10^{-4}	11,647	~ 35
	WI-17	12,774	2×10^{-4}	13,774	2×10^{-4}	16,851	~ 65
WI-3	WI-3	556	--	--	--	1,056	50
	WD-3	2,380	1×10^{-2}	3,940	6×10^{-4}	1,160	50
	WI-6	9,688	1×10^{-3}	3,940	6×10^{-4}	12,785	~ 100

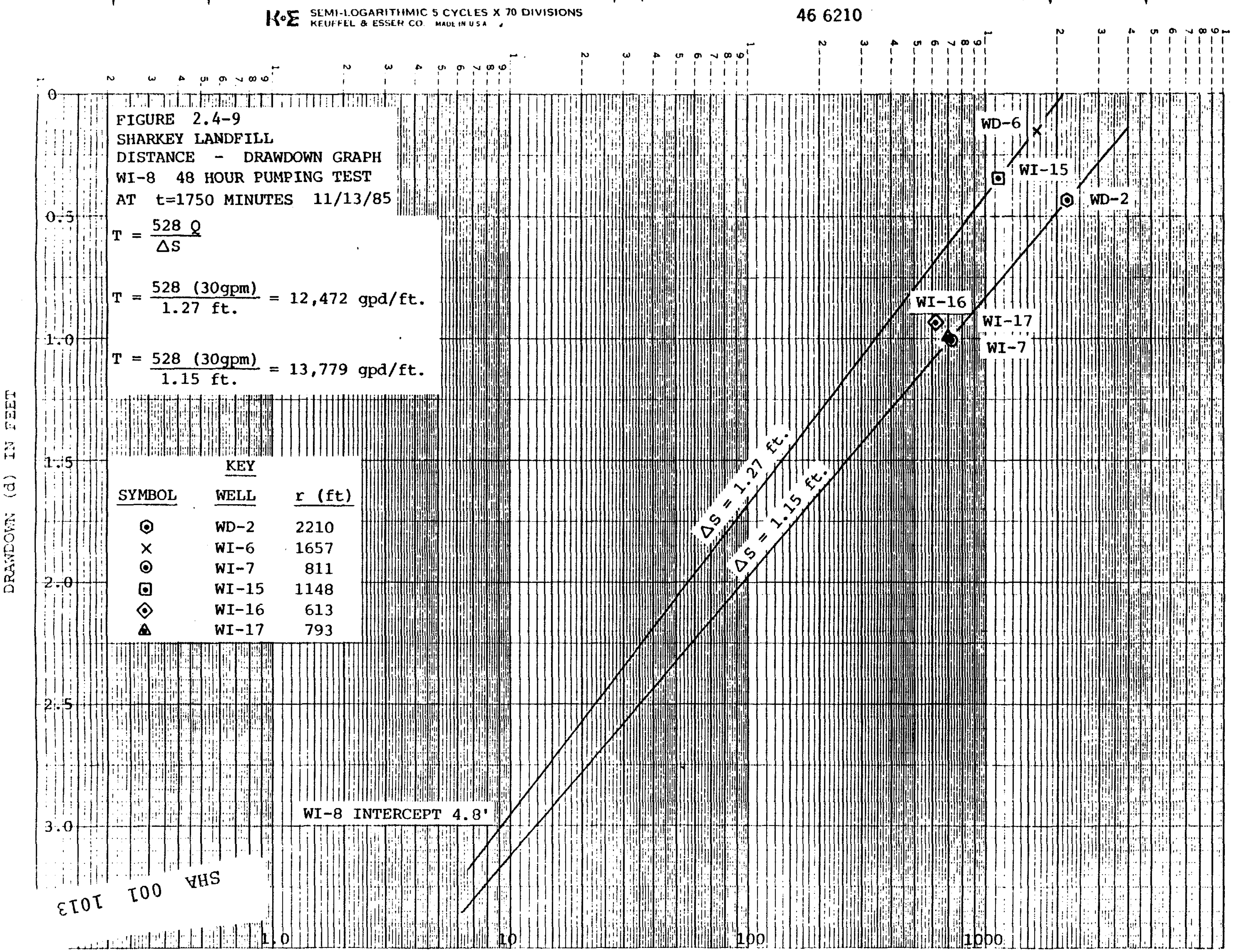
-- Not calculated due to method or test restrictions.

observation wells was probably caused by compression of the lower confined aquifer due to the added weight of the water in the river.

The maximum drawdown effect from pumping in the lower aquifer, prior to the external interference causing the increase in piezometric head in the lower aquifer, was observed at 175Ø minutes. Figure 2.4-9 is a distance-drawdown plot from which transmissivities were calculated. The observed drawdown in observation wells was also used to construct Figure 2.4-1Ø which represents the piezometric head distribution in the lower aquifer at t=175Ø minutes during the Well WI-8 pumping test. The data indicates a maximum radius of drawdown of approximately 17ØØ feet to the north and at least 2,4ØØ feet to the east and south. The lack of observation points in the lower aquifer to the northeast and west prevented determination of the drawdown effects further in these directions.

The cone of pumping influence is elliptical, with the long axis oriented northeast/southwest. This was caused by prevailing flow patterns and apparent anisotropic characteristics of the aquifer, suggesting a preferential permeability trending perpendicular to the long axis of the ellipse, or northwest/southeast. These conditions are probably the result of extensive depositional features of the lower aquifer, such as channelized or shoreline deposits, possibly reflective of Pleistocene Era flow patterns.

The pumping of WI-8 had no apparent hydraulic effect on the shallow aquifer, according to observations at Well WS-8.


K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6210
FIGURE 2.4-9
SHARKEY LANDFILL
DISTANCE - DRAWDOWN GRAPH
WI-8 48 HOUR PUMPING TEST
AT t=1750 MINUTES 11/13/85
T = 528 Q / ΔS
T = 528 (30gpm) / 1.27 ft. = 12,472 gpd/ft.
T = 528 (30gpm) / 1.15 ft. = 13,779 gpd/ft.
KEY
SYMBOL WELL r (ft)
WD-2 2210
WI-6 1657
WI-7 811
WI-15 1148
WI-16 613
WI-17 793
WD-6
WI-15
WD-2
WI-16
WI-17
WI-7
ΔS = 1.27 ft.
ΔS = 1.15 ft.
WI-8 INTERCEPT 4.8'
DRAWDOWN (d) IN FEET
0
0.5
1.0
1.5
2.0
2.5
3.0
1.0
10
100
1000

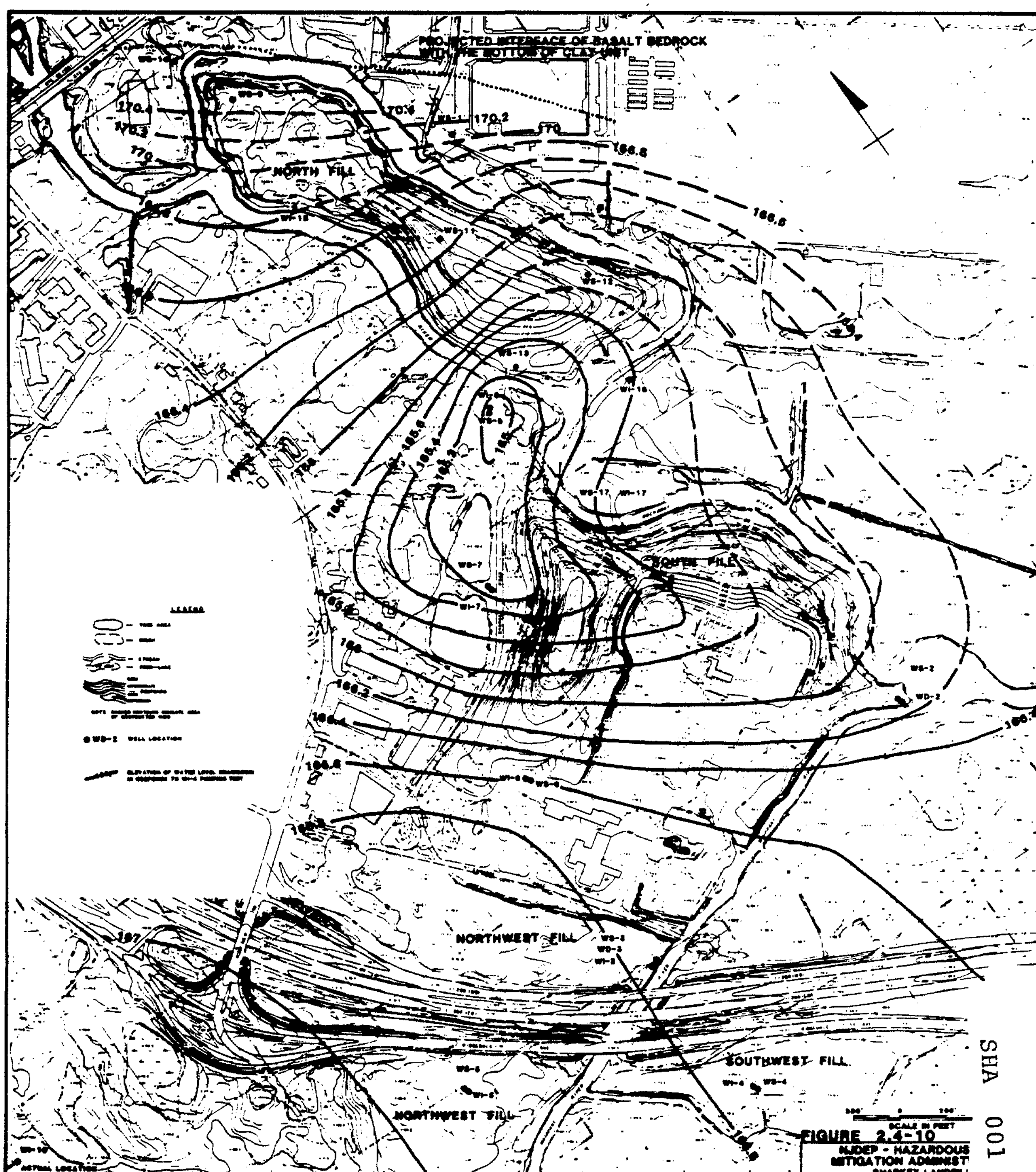


FIGURE 2.4-10
NJDEP - HAZARDOUS
MITIGATION ADMINIST
SHARKEY LANDFIL
PUMPING WATER LEVEL (
LOWER AQUIFER WI-

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Figure 2.4-11 shows the effect of lower aquifer pumping on the shallow aquifer at Well WS-8, adjacent to the pumping center.

Figure 2.4-12 displays the recovery of the lower aquifer at observation wells. The slow recovery of water levels after pumping stopped further reflects the constriction of flow in the lower aquifer by thinning of the aquifer near the bedrock interface. Transmissivity values calculated by recovery data were generally similar to those determined from drawdown.

2.4.3.5 Well WI-3 Pumping Test - Water level recorders were installed on WD-3, WD-2, WI-4, WI-5, and WI-6 to observe groundwater conditions prior to and during the WI-3 pumping test. The test was started on November 19, 1985 at an initial pumping rate of 10 gpm, and was increased to 20 gpm within 30 minutes. Figure 2.4-13 shows the time-drawdown and residual drawdown plot of Well WI-3 during the test. The drawdown effect of the step from 10 to 20 gpm is evident on the graph, and the 20 gpm portion of the curve was used in the calculations of transmissivity and storativity. The specific capacity of WI-3 was 1.8 gpm/ft.

Drawdown effects from pumping were observed at WD-3 and WI-6, which are screened in the lower aquifer. However, no drawdown effects were observed at Well WD-2 or in the shallow aquifer. The response at Wells WI-4 and WI-5 as a result of pumping at WI-3 could not be determined due to natural declines in piezometric levels throughout the area during the pumping test, such that levels in the wells continued to decline after the pumping was stopped.

The Rockaway and Whippany Rivers were at relatively high levels following 2.2 inches of rain which occurred the day before the WI-3 pumping test. These conditions could have resulted in

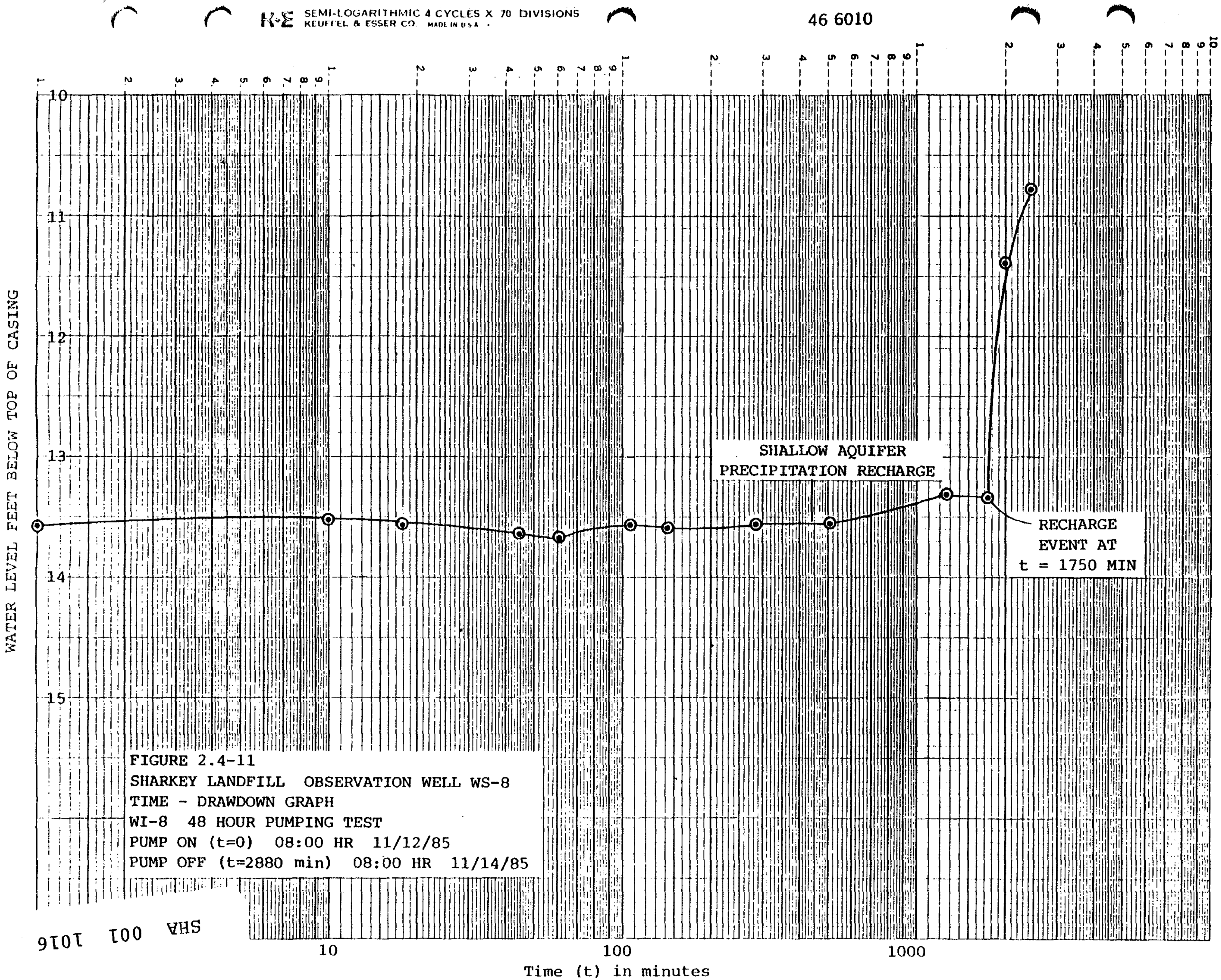

FIGURE 2.4-11
SHARKEY LANDFILL OBSERVATION WELL WS-8
TIME - DRAWDOWN GRAPH
WI-8 48 HOUR PUMPING TEST
PUMP ON (t=0) 08:00 HR 11/12/85
PUMP OFF (t=2880 min) 08:00 HR 11/14/85

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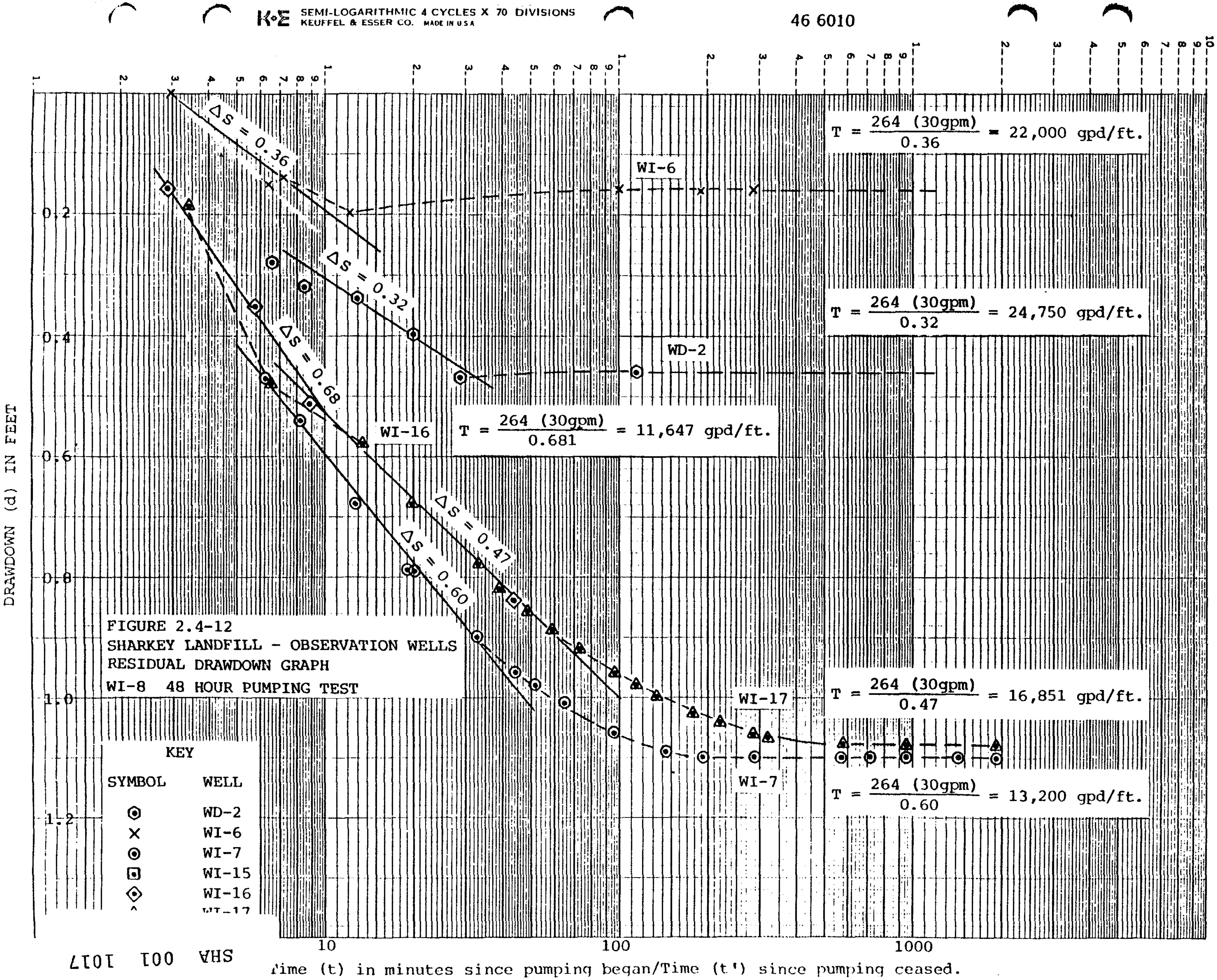


FIGURE 2.4-12
SHARKEY LANDFILL - OBSERVATION WELLS
RESIDUAL DRAWDOWN GRAPH
WI-8 48 HOUR PUMPING TEST

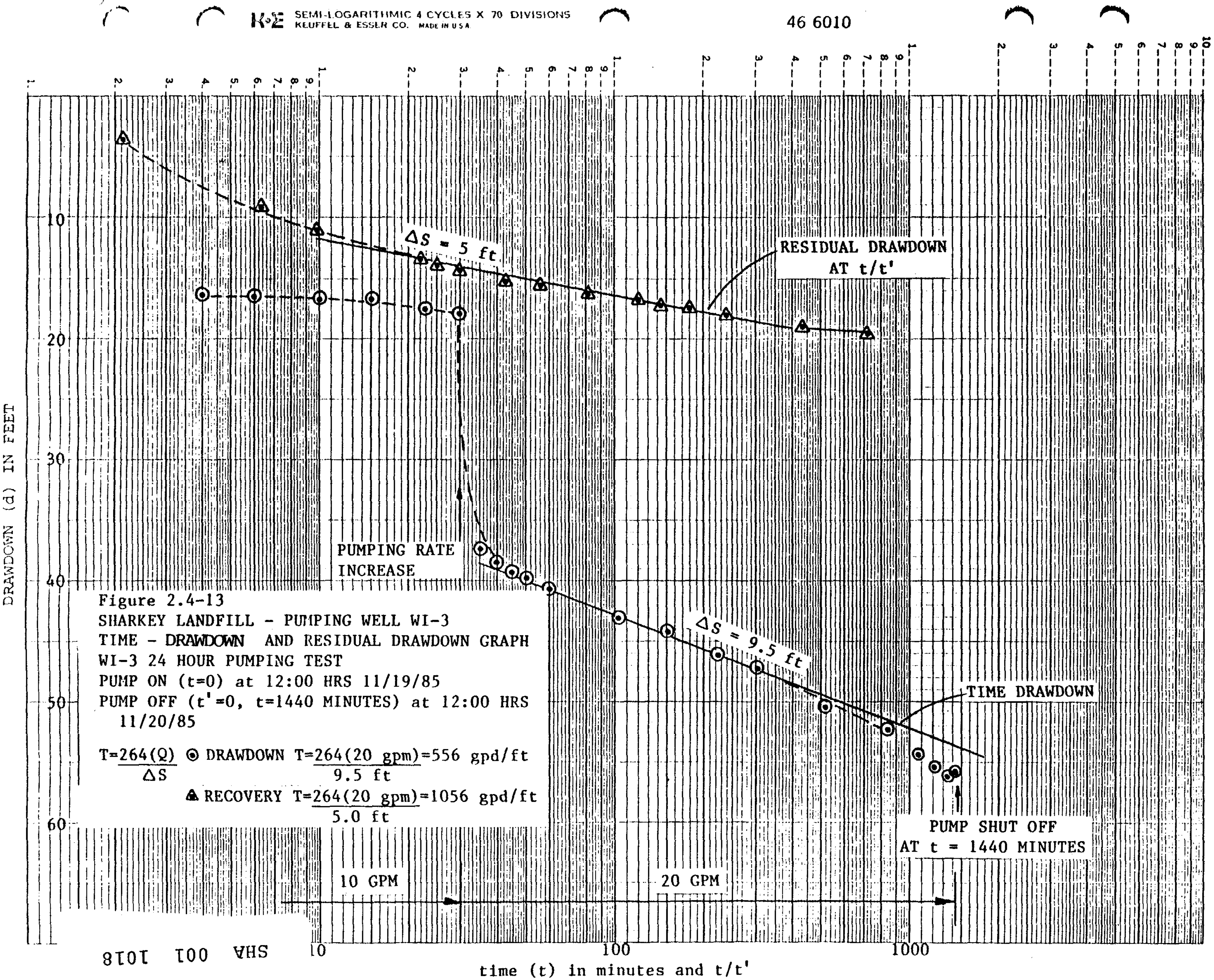


Figure 2.4-13
SHARKEY LANDFILL - PUMPING WELL WI-3
TIME - DRAWDOWN AND RESIDUAL DRAWDOWN GRAPH
WI-3 24 HOUR PUMPING TEST
PUMP ON (t=0) at 12:00 HRS 11/19/85
PUMP OFF (t'=0, t=1440 MINUTES) at 12:00 HRS 11/20/85

$T=\frac{264(Q)}{\Delta S}$ ⊙ DRAWDOWN $T=\frac{264(20\text{ gpm})}{9.5\text{ ft}}=556$ gpd/ft

▲ RECOVERY $T=\frac{264(20\text{ gpm})}{5.0\text{ ft}}=1056$ gpd/ft significant pressure changes on the confined lower aquifer, and alteration in aquifer storage capabilities during the test, similar to the responses observed during the WI-8 pumping test when increases in piezometric levels were observed in intermediate wells following rapid river level change. During the WI-3 pumping test, declining river stages during and after the test caused an overall reduction in observed piezometric water levels, and prevented Well WI-4 and WI-5 from recovering to initial water levels after the pumping test. Estimates of transmissivities however, were calculated (Table 2-6) from time-drawdown and risidual drawdown observations at WI-3, WD-3, and WI-6, shown in Figures 2.4-14 and 2.4-15, respectively.

A distance-drawdown curve is presented on Figure 2.4-16. This figure indicates that the radius of WI-3 pumping effect extended more than 1ØØØ feet to the north of WI-3 during the test.

2.4.3.6 Summary of Results/Pumping Tests - Lower aquifer transmissivities (Table 2-6) were relatively greater in the northern portion of the site, indicating a greater potential for groundwater transport of contaminants in this area. The calculated storage coefficients suggest that the lower aquifer is a relatively confined flow system with low potential for vertical flow via leakage.

The lower aquifer thickness at WD-2 is about 2Ø feet, but at WI-6 the aquifer is estimated to be approximately 1ØØ feet in thickness. Therefore, permeability of the aquifer at WD-2 is up to five times greater than at WI-6 as indicated by the similar transmissivity values calculated for these locations. Wells WI-7, WI-17 and WI-16 also indicated comparable transmissivities,

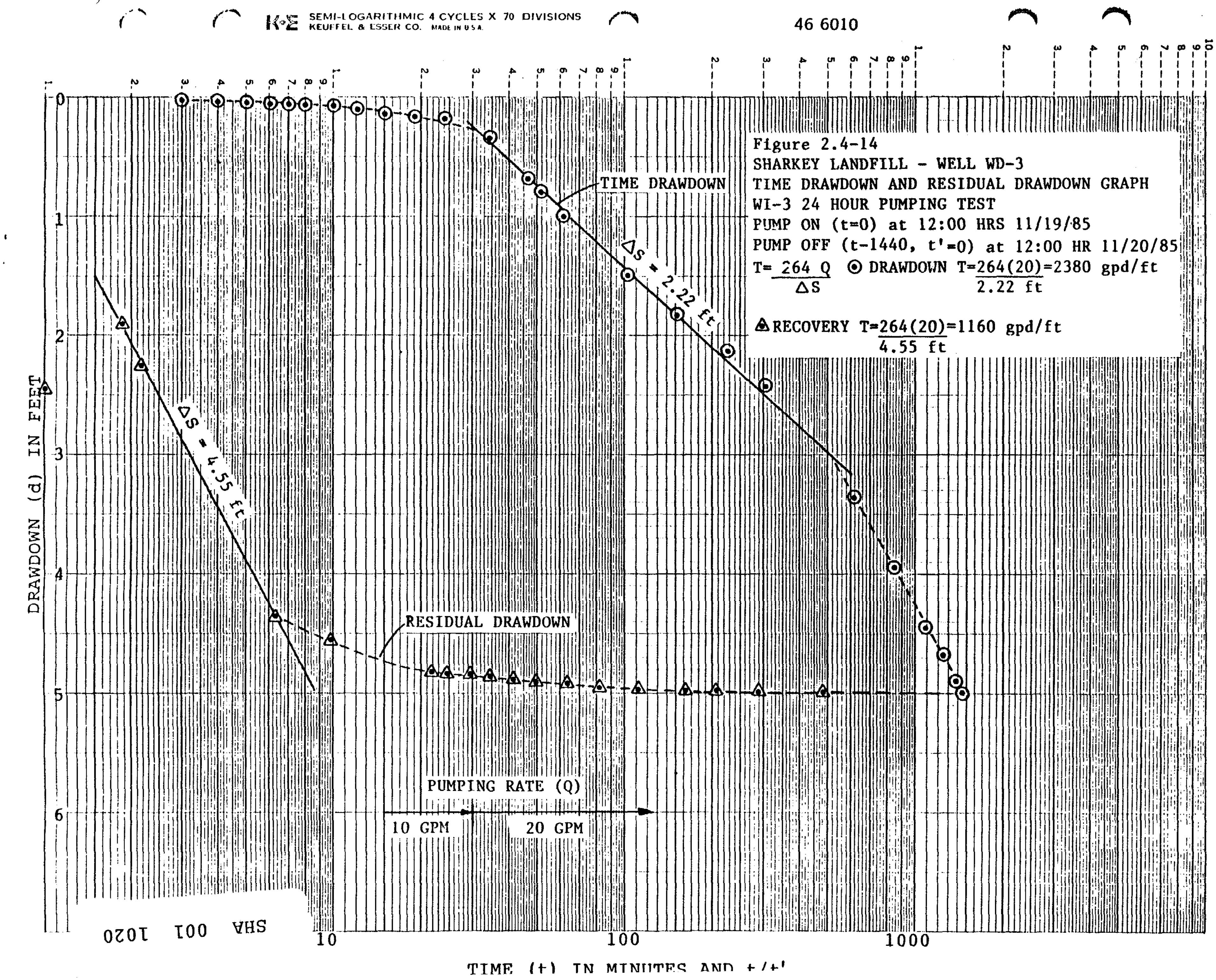


Figure 2.4-14
SHARKEY LANDFILL - WELL WD-3
TIME DRAWDOWN AND RESIDUAL DRAWDOWN GRAPH
WI-3 24 HOUR PUMPING TEST
PUMP ON (t=0) at 12:00 HRS 11/19/85
PUMP OFF (t-1440, t'=0) at 12:00 HR 11/20/85

$T = \frac{264\ Q}{\Delta S}$ ⊙ DRAWDOWN $T = \frac{264(20)}{2.22\ ft} = 2380$ gpd/ft

△ RECOVERY $T = \frac{264(20)}{4.55\ ft} = 1160$ gpd/ft

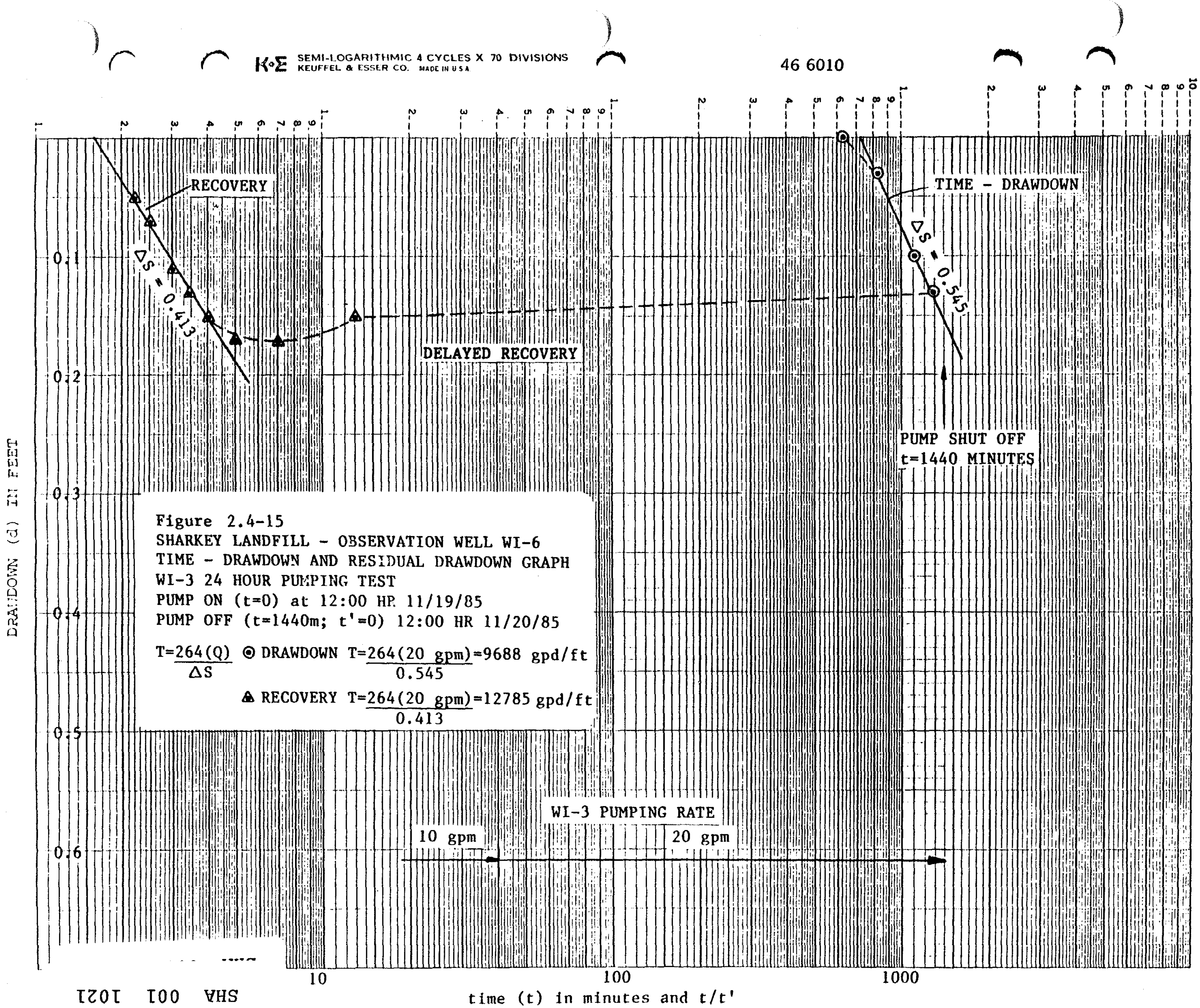


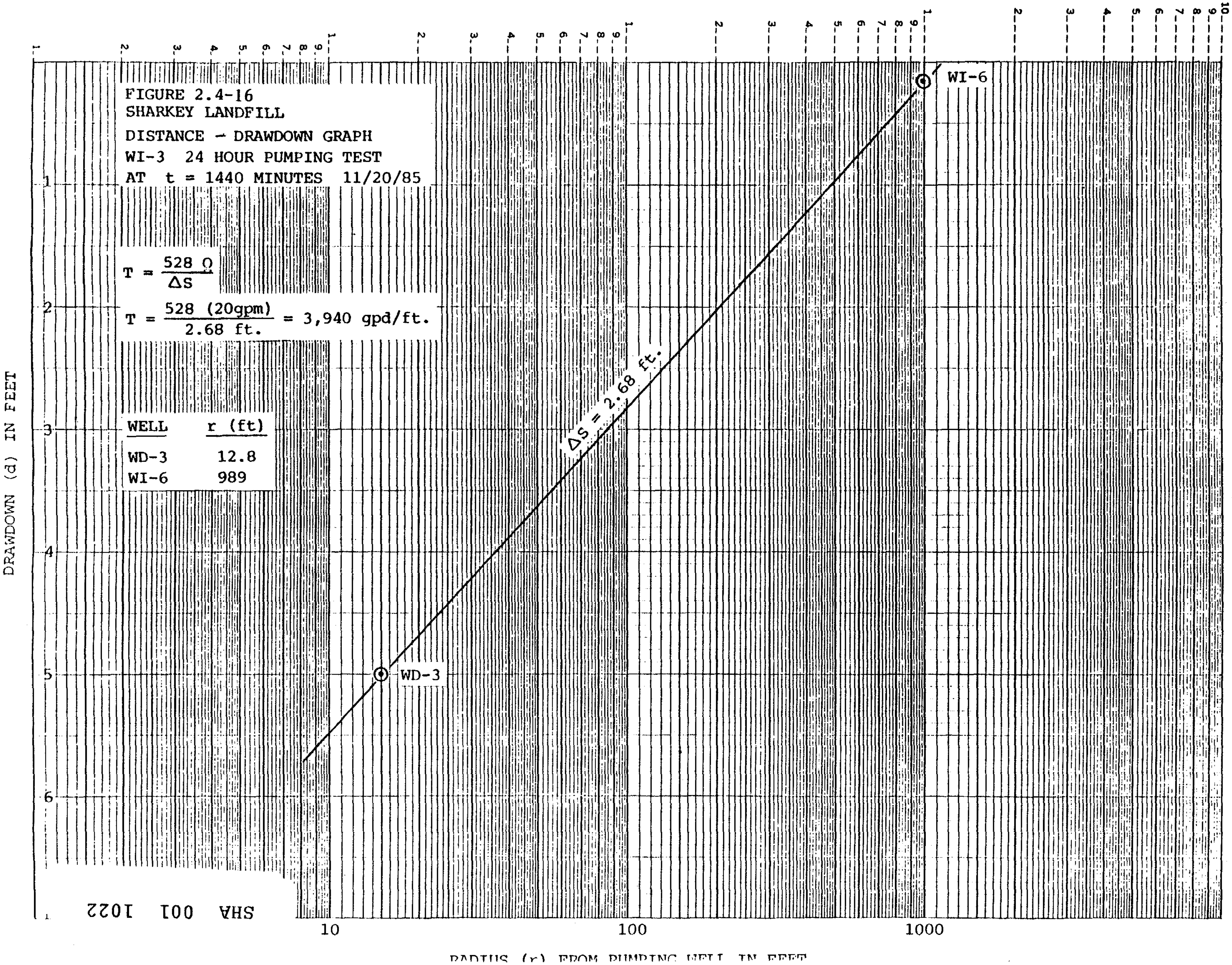
Figure 2.4-15
SHARKEY LANDFILL - OBSERVATION WELL WI-6
TIME - DRAWDOWN AND RESIDUAL DRAWDOWN GRAPH
WI-3 24 HOUR PUMPING TEST
PUMP ON (t=0) at 12:00 HR 11/19/85
PUMP OFF (t=1440m; t'=0) 12:00 HR 11/20/85

$T=\frac{264(Q)}{\Delta S}$ ⊙ DRAWDOWN $T=\frac{264(20\text{ gpm})}{0.545}=9688$ gpd/ft

▲ RECOVERY $T=\frac{264(20\text{ gpm})}{0.413}=12785$ gpd/ft

K+E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6010



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but their permeabilities vary by a factor of two due to the ratio of their respective aquifer thicknesses.

Due to changing aquifer conditions during the pumping test at WI-3, no reliable hydrologic information was obtained for the pumping test in the southern end of the lower aquifer. In these areas, geologic observations during drilling indicated a thick sequence of fine grained material, which would appear to be generally lower in overall permeability, although quantification cannot be addressed with the present data.

2.5 Data Analysis and Interpretation - Hydrogeology

2.5.1 Definition of Landfill Area Groundwater Flow Systems

There are three aquifer flow systems that underlie the Sharkey Landfill site. These flow systems include:

1. <u>Shallow aquifer</u>: composed of saturated alluvial silts, sands, gravels and landfill refuse; unconfined (water table conditions);

2. <u>Lower aquifer</u>: composed of glacial outwash sediments texturally ranging from sandy silt to coarse gravel; confined to semi-confined; and

3. <u>Bedrock aquifer</u>:

   a) <u>Basalt</u>; outcrops to the north of the site, and slopes beneath the unconsolidated deposits found at the surface of the site.

   b) <u>Brunswick Shale</u>; presence inferred from published regional mapping. Not encountered in RI/FS subsurface explorations; contact zones with local basalt flow unknown.

The scope of the RI/FS precluded an assessment of the bedrock unit in terms of hydrology. The bedrock aquifer may be couple to, or isolated from, the lower confined aquifer, or it m connect the two lower and shallow aquifers in the area north of the site, at the varved clay/bedrock interface.

The shallow water table aquifer is separated from the lower aquifer by the silty clay unit. Under the landfill, this unit is between 15 and 40 feet thick, possesses a low permeability and appears to provide significant hydraulic isolation between the shallow and lower unconsolidated aquifers.

2.5.1.1 Shallow Aquifer - The shallow aquifer is relatively limited in areal extent in the vicinity of the landfill. It has a recharge area that extends only about 900 feet west of the site and is truncated by the Rockaway and Whippany Rivers north and east of the landfill. No public groundwater supplies are known to be derived from this unit in the area. There are, however, records of private wells in the vicinity of the landfill that may tap this aquifer. Three such wells have been selected and sampled as part of this RI/FS (see Section 3.1.3).

The shallow aquifer is of major importance to the site investigation because it is the most probable medium of contaminant transport from the site. Contaminants contained within saturated fill deposits, or carried by infiltrating precipitation through the fill, have direct access to this shallow aquifer and may be transported by groundwater flow.

The texture of the shallow aquifer materials varies from coarse sand and gravel to well graded fine sand and silt. Slug test results, described in Section 2.4.2, indicate that permeabilitie of the natural shallow aquifer materials range from 1.6 10^{-4} cm/s (3.4 gpd/ft) to 1.1 x 10^{-2} cm/s (2.5 x 10^{2} gpd/ft Two shallow aquifer wells screened in landfill refuse displa relatively high permeabilities of 4.8 x 10^{-3} to 5.2 x 10^{-3} c

(1.0 x 10^{-2} to 1.1 x 10^{-2} gpd/ft). The overall effective porosity for this aquifer has been estimated at 30%.

2.5.1.2 Gray Varved Clay Aquitard - The varved clay aquitard forms a confining unit between the shallow aquifer and the lower aquifer. Eight undisturbed (Shelby tube) soils samples of the aquitard were taken from six borings in the varved clay during the RI/FS. Results of laboratory permeability (hydraulic conductivity) tests determined that the varved clay unit has a permeability ranging between 1.08 x 10^{-7} cm/s to 1.49 x 10^{-7} cm/s as discussed in Section 2.1.3. The porosity of this unit is estimated at 40%.

An isopach map of the varved clay unit thickness is shown as Figure 2.3-4 in Section 2.3. Clay unit thicknesses of 15 to 40 feet underlie the landfill; however, the clay unit surface structures suggest that post-depositional scouring and possible isostatic distortion of this unit may have occurred. These secondary effects may have resulted in localized shearing, fracturing or hydraulic breakthrough of the unit. There is, however, no physical evidence to indicate that a relatively permeable hydraulic connection between the shallow and lower aquifer exists through the clay unit. The potential for leakage through the unit is based on observed permeability characteristics and in this regard, the varved clay unit represents a groundwater flow medium, with extremely limited vertical flow potential.

2.5.1.3 Lower Aquifer - The lower confined aquifer is also a possible pathway of contaminant migration from the site. The importance of this aquifer stems from the potential volume of groundwater storage, the quantity of groundwater flow beneath the

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landfill, and its present and potential use as a drinking water source.

The aquifer is composed primarily of red to reddish-brown glacial outwash materials. The observed textural characteristics of the lower aquifer suggest that the materials are generally coarser at lower levels in the interval, fining upward, grading to the confining gray varved clay unit. Textural observations also suggest that laterally, coarser materials such as sand, pebbles and cobbles are prevalent to the north where the unit is thin, grading to finer sediments as the unit thickens to the southwest.

The lower aquifer is confined between the relatively low permeability materials of the varved clay unit above, and the bedrock aquifer below. Aquifer confinement provides storativity values of $1\emptyset^{-3}$ to $1\emptyset^{-4}$, estimated from the pumping test data. The thinning of the lower aquifer to the north, and the rapid thickening and fining of material to the southwest is also a significant influence on storage potentials in these areas. The lower aquifer ranges in estimated thickness from Ø to greater than 1ØØ feet, suggesting that the unit fills a former basin-like structure to the south and southwest.

The permeabilities determined by lower aquifer pumping tests, shown on Table 2-7, range from $9.8 \times 1\emptyset^{-4}$ to $5.9 \times 1\emptyset^{-2}$ cm/s, vaguely suggesting a gradual decrease in permeability to the south across the area. Anisotropic aquifer characteristics cause preferential permeability characteristics oriented northwest to southeast, parallel to the bedrock/varved clay contact area. This alignment of permeabilities may be due to previous shoreline deposits, orientation of former stream channels, or the geometry

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Table 2-7

Estimated Permeability Values - Lower Aquifer

Well	cm/s	ft/day	gpd/ft^2
WD-2	5.90×10^{-2}	1.68×10^{2}	1.26×10^{3}
WD-3	1.08×10^{-3}	3.07×10^{1}	2.30×10^{1}
WI-3	9.86×10^{-4}	2.81×10^{1}	2.1×10^{1}
WI-6	1.7 x 10-2 (5.24×10^{-3})	1.49×10^{1}	2.51×10^{2} (1.12×10^{2})
WI-7	7.67×10^{-3}	2.19×10^{1}	1.64×10^{2}
WI-8	1.05×10^{-2}	3.02×10^{1}	2.26×10^{2}
WI-15	4.86×10^{-2}	1.38×10^{2}	1.04×10^{3}
WI-16	1.68×10^{-2}	4.81×10^{1}	3.60×10^{2}
WI-17	1.04×10^{-2}	2.98×10^{1}	2.23×10^{2}

( ) value from WI-3 pumping test

of the confining units. The overall porosity of this unit, for the purpose of calculations, has been estimated at 40%.

2.5.2 Site Hydrology

A hydrologic budget evaluation was performed to assess the flux of water into and through the landfill and to evaluate potential remedial alternatives. The basic premise of the water budget assumes that, averaged over many years, the amount of water entering a groundwater system is equal to the amount of water leaving it. Once on the ground, precipitation (P) either runs over the surface of the ground to a stream and is transported away as surface runoff (R_s), is returned to the atmosphere by evaporation or transpiration (ET) or percolates to the groundwater system and eventually discharges to a stream or other aquifer (R_g). The basic water cycle in terms of the individual components involved can be stated as:

$$P = R_s + R_g + ET \pm \Delta S$$

Change in storage (ΔS) refers to the change in the amount of water stored in the ground. Over a period of many years, $\Delta S = 0$.

In addition, calculations of groundwter flow rates are usually based upon hydrologic parameters that are often based on broad estimates or the results of limited testing. As such, aquifer homogeneity and idealized conditions in the subsurface are often assumed by necessity. Therefore, many of the flow calculations should best be considered as order of magnitude estimates.

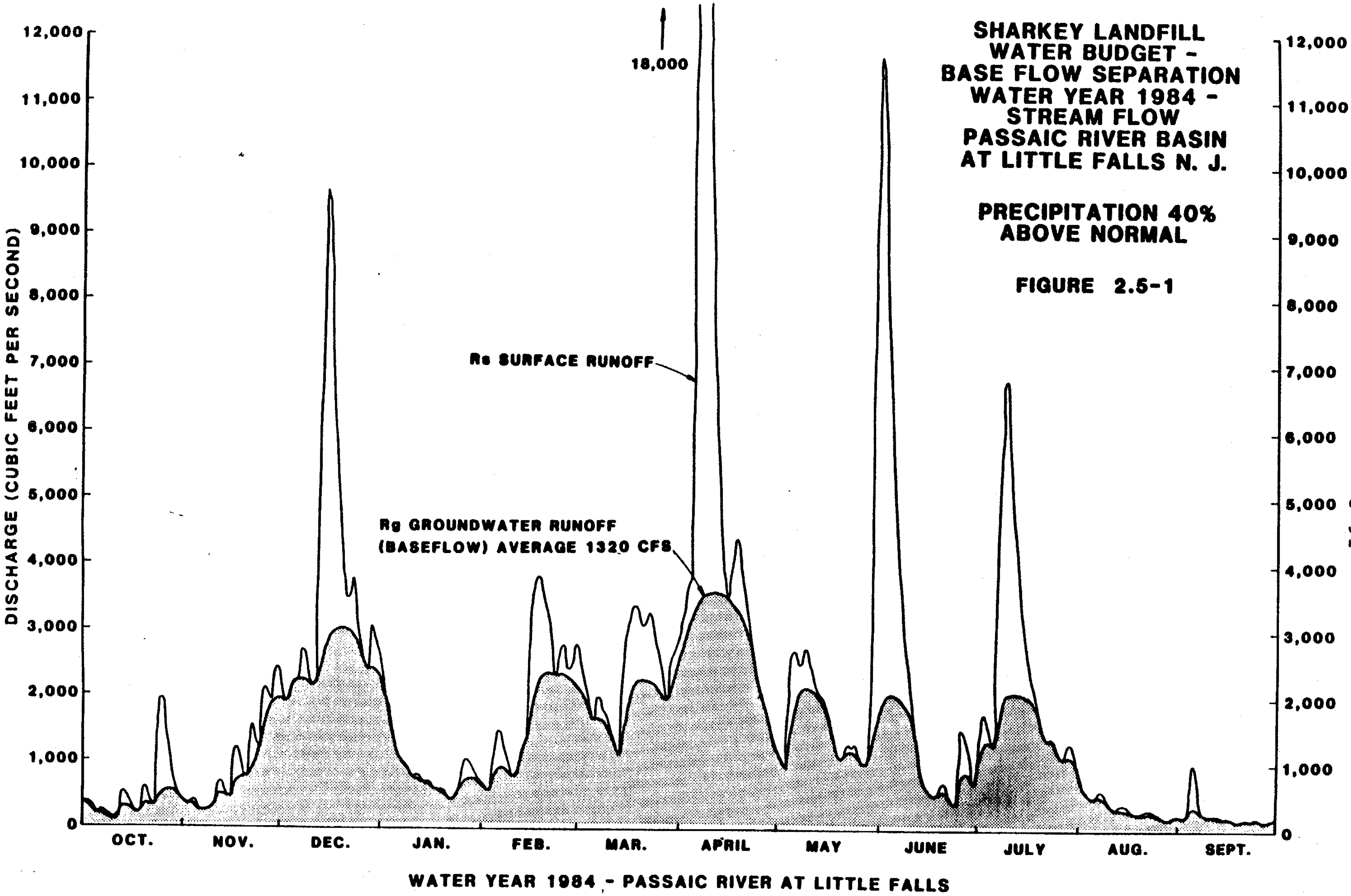
Furthermore, to assume that contaminants migrate at the same rate as groundwater would be an oversimplification of a complex system. Physical and chemical properties, such as solubility, polarity and density, play a key role in the distribution of contaminants, and may increase or decrease the rate at which contaminants migrate relative to groundwater flow. Soil properties are also integral in the process, because interaction between the contaminants and the soil media may occur causing sorption, retardation, degradation or precipitation.

2.5.2.1 Groundwater Recharge

2.5.2.1.1 Area Discharge Method - To isolate the groundwater influx portion (R_g) of stream flow, a hydrograph separation analysis was conducted. In the absence of long-term stream gaging records at the landfill and the artificial flow control mechanisms on the Rockaway River upstream, records from a gaging station downstream on the Passaic River at Little Falls, New Jersey were used. It is assumed that the base flow conditions in the Passaic River basin are similar to those found in the general vicinity of the landfill since the watersheds are similar in climate, geology, topography, natural vegetative cover, agriculture, and urbanization.

The 1984 water year (October 1983 through September 1984) was selected for analysis. The Passaic River hydrograph for that year is shown on Figure 2.5-1 and the total river flow is separated into surface runoff (R_s) and groundwater runoff (R_g) components.

Total precipitation at Boonton, N.J. during the 1984 water year was 66.56 inches (NOAA), which is equivalent to approximately 3.17×10^6 gpd/mi^2. During that year, the groundwater recharge


SHARKEY LANDFILL
WATER BUDGET -
BASE FLOW SEPARATION
WATER YEAR 1984 -
STREAM FLOW
PASSAIC RIVER BASIN
AT LITTLE FALLS N. J.
PRECIPITATION 40%
ABOVE NORMAL
FIGURE 2.5-1
18,000
Rs SURFACE RUNOFF
Rg GROUNDWATER RUNOFF
(BASEFLOW) AVERAGE 1320 CFS
DISCHARGE (CUBIC FEET PER SECOND)
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
OCT.
NOV.
DEC.
JAN.
FEB.
MAR.
APRIL
MAY
JUNE
JULY
AUG.
SEPT.
WATER YEAR 1984 - PASSAIC RIVER AT LITTLE FALLS

(R_g) to the basin is estimated (NOAA) at 1.12×10^6 gpd/mi^2 or approximately 35.3% of total precipitation. The remaining 2.05×10^6 gpd/mi^2 of precipitation to the basin can be accounted for in the R_s, ET or ΔS components of the water cycle.

Precipitation in the drainage basin during the 1984 water year was about 39% above the average total annual precipitation of 47.85 inches (NOAA). Groundwater recharge (R_g) for the average water year can be estimated by using the 1984 water year total groundwater recharge to precipitation proportion of 35.3%. This yields an average annual groundwater recharge (R_g) value of about 8×10^5 gpd/mi^2 (1250 gpd/acre) for the Passaic River basin above Little Falls.

The RI/FS field investigations were conducted during the 1985 water year. Total precipitation during that year was measured at 41.69 inches (NOAA) at the Boonton Station. Applying the same 35.3% ratio between groundwater recharge and precipitation, the recharge value in the study area for 1985 would be about 7×10^5 gpd/mi^2, or 1,094 gpd/acre, approximately 13% less than the average.

2.5.2.1.2 Darcy's Law Method - The volume of groundwater flowing through a cross sectional area of an aquifer can be estimated using Darcy's Law, where:

$$Q = K \frac{dh}{dx} A$$

Where:

Q = Total aquifer discharge rate = (gpd)
K = Aquifer permeability (gpd/ft^2)

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$\frac{dh}{dx}$ = Hydraulic gradient (ft/ft)

A = Aquifer cross sectional area (ft^2)

Use of Darcy's Law in the shallow unconfined aquifer requires compensation for the change in aquifer saturated thickness along the flow path. Therefore, by integration Darcy's Law becomes:

$$Q = \frac{Kd}{2} \frac{(h2^2 - h\ ^2)}{x_2 - x_1}$$

Where:

Q = total aquifer discharge rate (gpd)
K = aquifer permeability (gpd/ft^2)
h = aquifer saturated thickness (ft)
x = length of flow path (ft)
d = length of cross section (ft)

2.5.2.2 Groundwater Velocity - The velocity of groundwater movement beneath the landfill essentially controls the rate and impact of contaminant migration in the aquifers. Waste buried in or contaminants infiltrating to the aquifer are moved downgradient with the groundwater flow. Assessment of travel time necessary for these materials to leave the site and in some manner endangering the environment, is critical in determining the remedial measures necessary to alleviate any groundwater contamination problems.

The velocity at which groundwater moves through the aquifer on a macroscopic scale is dependent on several hydraulic parameters; permeability, hydraulic gradient and aquifer porosity. Permeability is a function of aquifer textural characteristics that control groundwater flow conductivity under given head

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potential conditions. The hydraulic gradient reflects the force required to overcome frictional forces, and cause groundwater to move through the aquifer from areas of higher energy potential to those of lower potential. The hydraulic gradient is observed as a sloping water table in unconfined conditions or a piezometric surface in confined aquifer conditions. The groundwater velocity through aquifer materials (solids) and pore spaces is erratic in direction, and much faster than the mean groundwater velocity on a macroscopic scale. The aquifer porosity is required to evaluate the average advective groundwater velocity. Based on these parameters, the average groundwater velocity, on a macroscopic scale, can be calculated by:

$$\bar{v} = \frac{Ki}{N}$$

Where:

$\bar{v}$ = average macroscopic groundwater velocity (ft/day)

K = aquifer permeability (ft/day)
i = hydraulic gradient (dimensionless)
N = aquifer porosity (dimensionless)

Values of permeability and porosity for the respective aquifers are discussed in Sections 2.2 and 2.3. Hydraulic gradients, used in subsequent applications of this equation, were estimated from the water table or piezometric surface contour maps.

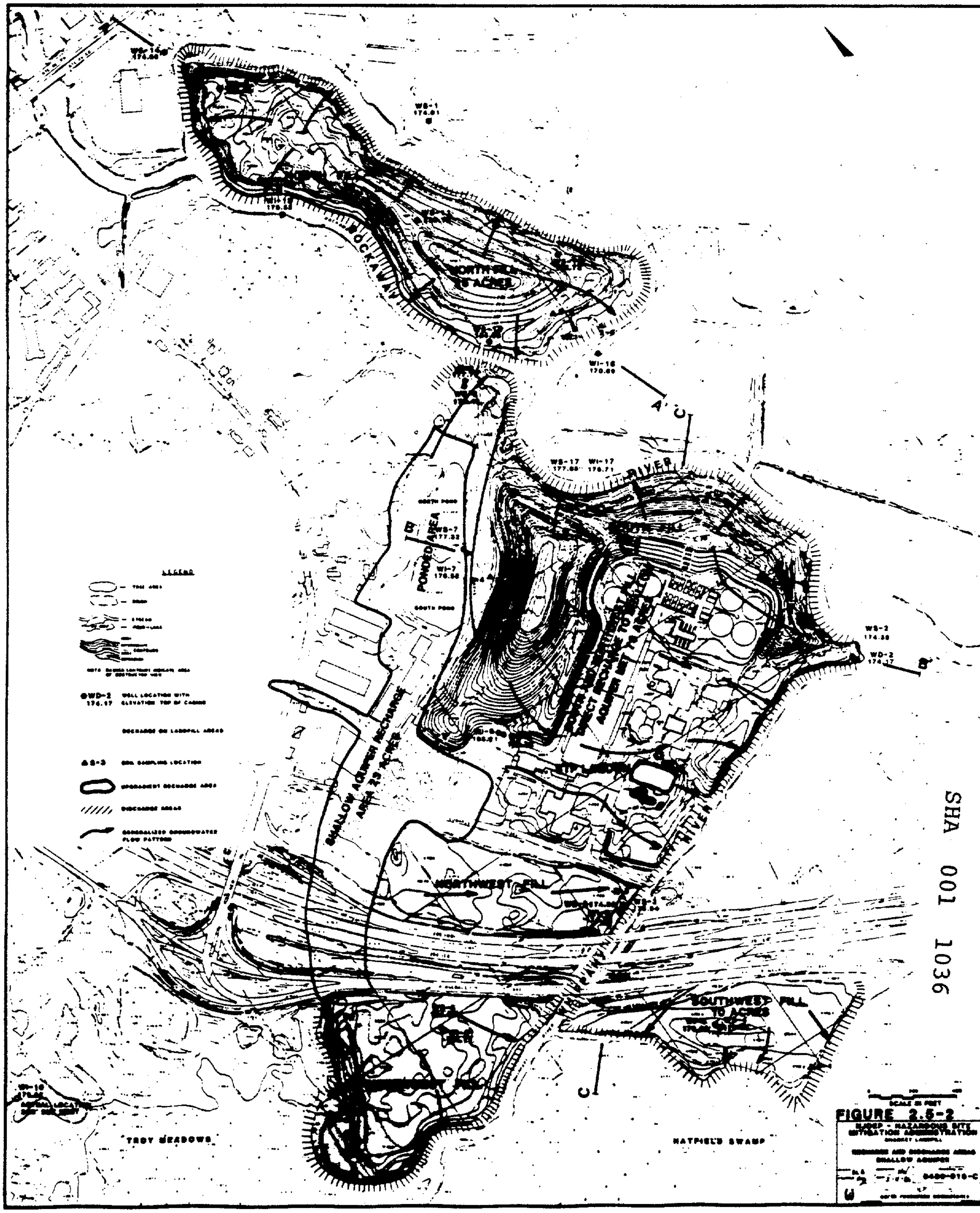
2.5.2.3 Groundwater Flow Characteristics - Shallow Aquifer

2.5.2.3.1 Flow Pattern - As shown on Figures 2.4-1 and 2.4-2 (Section 2.4.1) groundwater level surveys of the shallow aquifer indicate that flow patterns are largely dominated by surface topography and the relative location of recharge and discharge zones. Localized textural variations of aquifer materials, caused by alluvial channel deposits and related structures, are probably common throughout this vicinity. However, patterns have not been observed due to the limited number and wide spacing of borings. Local groundwater flow patterns beneath the landfill may therefore be significantly affected by smaller than observed structures.

2.5.2.3.2 Groundwater Recharge Areas - On the basis of topographic detail and observed site conditions, the recharge area for the shallow aquifer beneath the study area is approximately 13Ø acres, as shown on Figure 2.5-2. Of this total recharge area, about 23 acres is located to the west of the South Fill, outside and upgradient of the major fill areas.

Approximately three acres of the upgradient recharge area is covered by pavement or buildings. These areas potentially increase the surface runoff component (R_s) and thereby reduce the groundwater recharge (R_g) available by means of infiltration.

The two ponds to the northwest of the South Fill comprise about three acres of this upgradient recharge area, as shown on Figure 2.5-2. The ponded water on the western boundary of the landfill provides direct recharge to the shallow groundwater system by infiltration, since there is no apparent surface discharge from these depressions. Static water levels observed in Monitoring Well WS-7 were similar in elevation to the surface


LEGEND
NORTH FILL
PONDED AREA
NORTHWEST FILL
SOUTHWEST FILL
RIVER
TROY MEADOWS
HATFIELD SWAMP
FIGURE 2.5-2

water elevation recorded in the adjacent ponds. However, variations observed in pond water level elevations indicate that these ponds are not hydraulicly interconnected. The water level in each pond fluctuates independently in response to runoff collection and infiltration. Groundwater flow from this vicinity is to the east and north under the landfill, toward the Rockaway River.

Fill areas of the site represent significant recharge zones due to the potentially high porosity of the fill materials. Groundwater mounding was observed within the 25 acre North Fill. Groundwater mounding is also expected to occur within the 73 acre South and Northwest Fill areas and in the 10 acre Southwest Fill area. Due to the mounding effect and the closed recharge area, radial groundwater flow within the North Fill is anticipated.

The Parsippany-Troy Hills STP operates an unlined lagoon used as a settling pond. On the basis of visual field observations, this lagoon is maintained at a hydrostatic head approximately 15 feet above the shallow aquifer water table. Data obtained from continuous groundwater level monitoring at Well WS-3, 560 feet from this structure, indicated groundwater mounding effects due to leakage from the lagoon, as discussed in Section 2.4.1. Groundwater flow from the lagoon discharges to the Whippany River.

2.5.2.3.3 <u>Groundwater Discharge Areas</u> - Discharge areas in the shallow aquifer are the Rockaway River, the Whippany River Hatfield Swamp and Troy Meadows. The Rockaway River surrounds the North Fill and forms the northern border of the South Fill. The Whippany River forms the eastern border of the South and the Northwest Fills and intersects the Rockaway River east of the landfill. The Southwest Fill discharges to Hatfield Swamp an the Whippany River via subsurface groundwater flow or a surface drainage ditch located to the south of the fill.

The source of shallow aquifer groundwater discharge to the rivers can be divided into three components:

1. Precipitation that falls on the 23 acre upgradient recharge area percolates to the shallow groundwater table and flows eastward under the fill to the rivers as groundwater;

2. Precipitation that falls directly on the fill, inflitrates downward through the refuse, and merges with groundwater flow migrating toward the rivers; and

3. Groundwater exchange from the lower aquifer through the varved clay unit and leakage from the STP lagoon that merges with shallow groundwater flow migrating toward the rivers.

2.5.2.3.4 Groundwater Flow Volumes - The following discussion presents the calculations that were made to determine the rate of groundwater recharge (infiltration) occurring through the various areas supplying recharge to groundwater flow within the shallow aquifer on the site. Assuming no change in groundwater storage, the rate of groundwater recharge for each area is equal to the rate of groundwater discharge. A summary of all calculations appears as Table 2-8.

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Table 2-8

Summary of Average Annualized Flow Rates For Components Of The Shallow Aquifer

	Groundwater Recharge Rate for Area Discharge	Darcy's Law Calculations
The upgradient area to the west of the South and Northwest Fills (23 acres)	28,000 (1,220 gpd/ac)	6,100 gpd
The South and Northwest Fills (73 acres)	91,500 gpd	152,000 gpd** (2,070 gpd/ac)
Groundwater Contribution from: The North Fill Area (25 acres)	51,750 gpd* (2,070 gpd/ac)	N.C.
The Southwest Fill (10 acres)	16,560 gpd* (2,070 gpd/ac)	N.C.
Infiltration from the STP lagoon	N.C.	25,000 gpd
Groundwater Discharge to the rivers from the South Fill Area	N.C.	205,000 gpd***

* An average infiltration value of 2,070 gpd/ac was determined on South and Northwest Fill and applied to North and Southwest Fill

** Landfill flow less upgradient groundwater and sewage lagoon leakage

***Includes: 28,000 gpd from upgradient area to the west (groundwater recharge rate), 152,000 gpd from south and Northwest fills and 25,000 gpd from STP Lagoon infiltration.

N. C. Not calculated with this method

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South and Northwest Fill Areas

The majority of area encompassed by the Sharkey Landfill is comprised of the South and Northwest Fills. The rate of groundwater recharge to the 23 acre upgradient western recharge area (see Figure 2.5-2) through the South and Northwest Fill areas was estimated at 6,100 gpd using Darcy's Law. The Area Discharge estimate for the same location, in water year 1985 is 28,000 gpd. Average annual recharge to this area is estimated at 32,000 gpd. The large difference between Darcy calculated R_g and Area Discharge R_g estimates probably resulted, to a considerable degree, from relatively low permeability estimates used in Darcy's Law calculations (WS-6 and WS-7), based on only two wells. Parameters used for groundwater flow calculations are provided in Appendix B-10.

The second component (Component 2) of shallow aquifer groundwater recharge into the South and Northwest Fill areas is comprised of groundwater originating as precipitation directly infiltrating the refuse areas. The volume of this component can be estimated as the difference between the total volume of groundwater leaving the landfill at the downgradient discharge areas (entering the rivers), shown on Figure 2.5-2, and the total volume originating in the 23 acre upgradient area (Component 1) combined with leakage through the varved clay and from the sewage plant lagoon (Component 3). Use of the Darcy equation indicated a total discharge from the South and Northwest Fill areas of 152,000 gpd. The Area Discharge method yields a groundwater recharge rate of 91,500 gpd. A comparison of these two values suggests that land area alterations due to the landfill have increased the natural rate of groundwater recharge in these areas.

The Parsippany-Troy Hills STP maintains a surface water impoundment (lagoon) for settling of solids from sewage sludge incineration process. This lagoon is unlined and interfaces with the shallow aquifer. Effects of the lagoon on the shallow aquifer hydrology have been observed by a continuous water level recorder at a distance of 560 feet south of the lagoon. An estimated permeability of 46 gpd/ft^2, averaged from slug test results of WS-3 and WS-2, enabled an estimate of leakage from this lagoon at a rate of about 25,000 gpd (Component 3) using Darcy's Law.

This lagoon flow, combined with shallow aquifer flow produces a mounding on the shallow water table surface which may induce limited downward leakage through the clay aquitard into the lower aquifer.

North and Southwest Fill Areas

Use of Darcy's equation to estimate groundwater recharge to the North and Southwest Fill areas was not possible due to the radial drainage pattern on the North Fill and limited permeability data for the shallow aquifer in the Southwest Fill. However an Area Discharge method estimate, based on an annualized recharge rate of 2,070 gpd/acre (as obtained for the South Fill) for the North and Southwest Fills provides an annualized infiltration rate of 51,750 gpd for the 25 acre North Fill and 16,560 gpd for the 8 acre Southwest Fill during an average water year. An infiltration rate of 2,070 gpd/acre compared to the average annual rate of 1,250 gpd is used to allow for additional infiltration resulting from the greater permeability of fill material.

2.5.2.3.5 Groundwater Flow Velocities - Shallow Aquifer - Rates of groundwater flow are greatest in the shallow aquifer because of the relatively greater permeability of fill materials and the steep hydraulic gradients. These gradients are related to the mounding of groundwater under the fill areas and the hydraulic sinks provided by the rivers which bound the site.

North Fill

Groundwater mounding is very evident within the North Fill, and the hydraulic gradient to the Rockaway River is steep on all sides. The North Fill aquifer is partially refuse, and is very permeable. Estimated groundwater velocities on the North Fill are the highest at the landfill, at 2 to 8 feet per day (ft/day). At this rate, contaminated groundwater entering the aquifer near the center of the North Fill would enter the Rockaway River in 25 to 125 days.

South Fill/Northwest Fill

The South Fill has several potential flow paths and discharge locations; therefore, groundwater velocity and related travel time can vary, depending on location. At the north end of the South Fill, groundwater flow enters the Rockaway River near WS-8. The source area for this flow is the vicinity of WS-7 and the ponds at the western border. The hydraulic gradient and the permeability of the aquifer between these wells is very low. Similarly, the groundwater flow velocity is very low ranging from 8×10^{-3} to 4×10^{-2} ft/day. The travel time along this flow path is calculated at a range of 55 to 275 years. If however, other flow paths and localized subsurface channels of higher permeability are present, this low permeability flow path assessment may be inaccurate.

Steeper gradients, higher permeabilities, and shorter flow paths are present on the South Fill in the vicinity of Well WS-17. The northern boundary of the South Fill in this area will support the highest groundwater velocities from the site, ranging between 2 and 13 ft/day. These flow rates result in travel time estimates of 2 to 1Ø days for off-site transport.

The majority the South and Northwest Fill areas drain toward the Whippany River. The gradients along this flow path are low and the measured permeabilities are moderately low. However, channels of higher permeability materials are expected; though not observed by the RI/FS. Based on observed hydrogeologic conditions in the South and Northwest Fill areas, the estimated average groundwater flow velocity ranges from 6×10^{-2} to 3×10^{-1} feet per day. Due to the substantial flow path lengths, travel times may be as much as 32 years in some source areas.

2.5.2.4 <u>Groundwater Flow Characteristics - Varved Clay Unit</u>

2.5.2.4.1 <u>Flow Volumes</u> - The Darcy equation (Section 2.5.2.1.3) was used to estimate the rate of vertical groundwater flow (exhange) through the varved clay aquitard. Since this flow path is a possible transport route for contaminants, knowing the flow rate is essential.

Vertical leakage of groundwater through the aquitard was estimated by applying laboratory permeabilities from Shelby tube analyses and field data interpretations. Laboratory permeabilities all ranged between 1.08×10^{-7} cm/s to 1.49 x

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10^{-7} cm/s (3×10^{-4} to 4×10^{-4} f/day). The varved clay was assumed to be present under the entire site.

The head differential contour map (Figure 2.4-6) and the varved clay isopach (thickness) map (Figure 2.3-4) were used to estimate the rate of leakage, or flow, through the clay unit. The head differential divided by the thickness represented the hydraulic gradient across the site influencing groundwater flow through the clay.

In performing the assessment, the site was divided into two areas according to direction of vertical gradient: upward or downward. These areas were further subdivided, and estimates of average thickness, head differential and hydraulic gradient in each area were made. The area of each subdivision was then determined, and the respective parameters were used in the Darcy flow equation for each subdivision Appendix B-6. The combined flows of the subdivisions determined the total amount of flow through the clay in either direction.

Using this analysis for the 1985 water year, it was estimated that downward groundwater flow occurs from the shallow aquifer to the lower aquifer at a rate of approximately 100 gpd, predominantly occurring in areas where groundwater mounding is evident, such as the North Fill, North and West perimeters of the South Fill, and under the STP lagoon.

Upward groundwater flow also occurs from the lower aquifer in the areas of relatively low topographic elevations around the rivers and the east side of the landfill. Total upward groundwater leakage occurs at a rate of approximately 40 gpd.

2.5.2.4.2 Groundwater Flow Velocity - Varved Clay Unit - To fully access all possible routes of migration, vertical transport through the varved clay must also be considered. Downward leakage of contaminated groundwater through the confining varved clay unit would be impeded by the extremely low permeabilities that are characteristic of this unit. Vertical groundwater flow velocities beneath the landfill in the aquitard range from no flow to 5 x 10^{-4} ft/day. Average flow rates under the site are approximately 6 x 10^{-5} ft/day. Associated travel times for groundwater to penetrate the clay, based on observed unit thickness, range from 164 years to 1,370 years. However, the rate at which contaminants flow through the aquitard may not be controlled by groundwater velocities.

At low groundwater flow velocities, molecular diffusion in all directions becomes a dominant dispersive and transport mechanism. Estimates of time required for contaminant penetration through the varved clay via molecular diffusion range from 238 to 1057 years. However, it is expected that some contamination will be absorbed by the unit itself.

2.5.2.5 Groundwater Flow Characteristics - Lower Aquifer

2.5.2.5.1 Groundwater Flow Volumes - Using Darcy's Law, the flow of groundwater through the western boundary of the study area in the lower confined aquifer was calculated. Based on aquifer permeabilities established from pumping test results at WI-8 and WI-3, hydraulic gradient maps and estimates of aquifer thickness from the drilling program, a lower aquifer groundwater discharge rate from beneath the landfill area of 1.2 million gallons per day was estimated. Since the size and location of

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the recharge area is unknown, the area discharge method cannot be applied.

Although a large portion of lower aquifer recharge may result from interformational leakage through the clay aquitard from the shallow aquifer, the volume of leakage through the aquitard is an insignificant contribution to that aquifer. Similarly, the volume of upward leakage that is returned to the landfill portion of the shallow aquifer is equally insignificant.

2.5.2.6 Groundwater Flow Velocity - Lower Aquifer - The impact of contaminant migration in the lower aquifer could be significant due to this unit's present and potential use as a water supply. Remediation of this aquifer if needed, could prove more difficult with time because of possible wide distribution of contaminants and large groundwater storage capacity.

Groundwater velocities in the lower aquifer are slower than in many areas of the shallow aquifer due to the minimal hydraulic gradient. Generally, the permeabilities in the lower aquifer are similar to or greater than the shallow aquifer. Channelization may influence localized flow at greater rates than estimated. In the northern portion of the site, groundwater flow rates exhibit extreme variability ranging from 8×10^{-2} to 8×10^{-1} ft/day. The general direction of this groundwater flow is to the west, and travel times in this area for groundwater to leave the site in this area is estimated to range between 1 and 2Ø years.

In the northeastern quadrant of the landfill, a small component of eastern flow has a velocity ranging from 2×10^{-1} to 5×10^{-1} ft/day. Groundwater from the eastern portion of the

North Fill would require 5 to 12 years to cross this area beneath the North Fill to a position below the Rockaway River.

Groundwater in the lower aquifer beneath the center of the South Fill flows to the west. Low hydraulic gradient and moderate to low permeabilities create a velocity range of 1×10^{-2} ft/day at WI-7 to 2×10^{-1} ft/day at WD-2. Travel times for migration beyond the study area range from 25 to 50 years along this path.

In the southwestern quadrant of the South and Northwest Fill, permeabilities are similar to the center of the site, but gradients increase so that north trending groundwater flow velocities range from 1×10^{-1} to 2×10^{-1} ft/day. Travel time for off-site movement can vary due to the diversity of flow paths available. The shortest flow path could require 2 years to leave the site, while a longer path could require more than 50 years.

A minor eastward flow path occurs from the southeastern quadrant of the Sharkey Landfill site. The very low permeability and low gradient indicate essentially insignificant flows along this path with velocities ranging from less than 1×10^{-3} ft/day. Travel times in excess of 100 years can be expected for groundwater flow under the Whippany River from this portion of the site under natural gradients.

2.5.3 Summary of Hydrologic Budget

Based upon the results of the analyses discussed in the preceding sections, a water budget summary (see Table 2-8) has been diagrammatically prepared as shown on Figure 2.5-3. This illustration shows projected rates of groundwater discharge from the site and leakage through the varved clay deposit.

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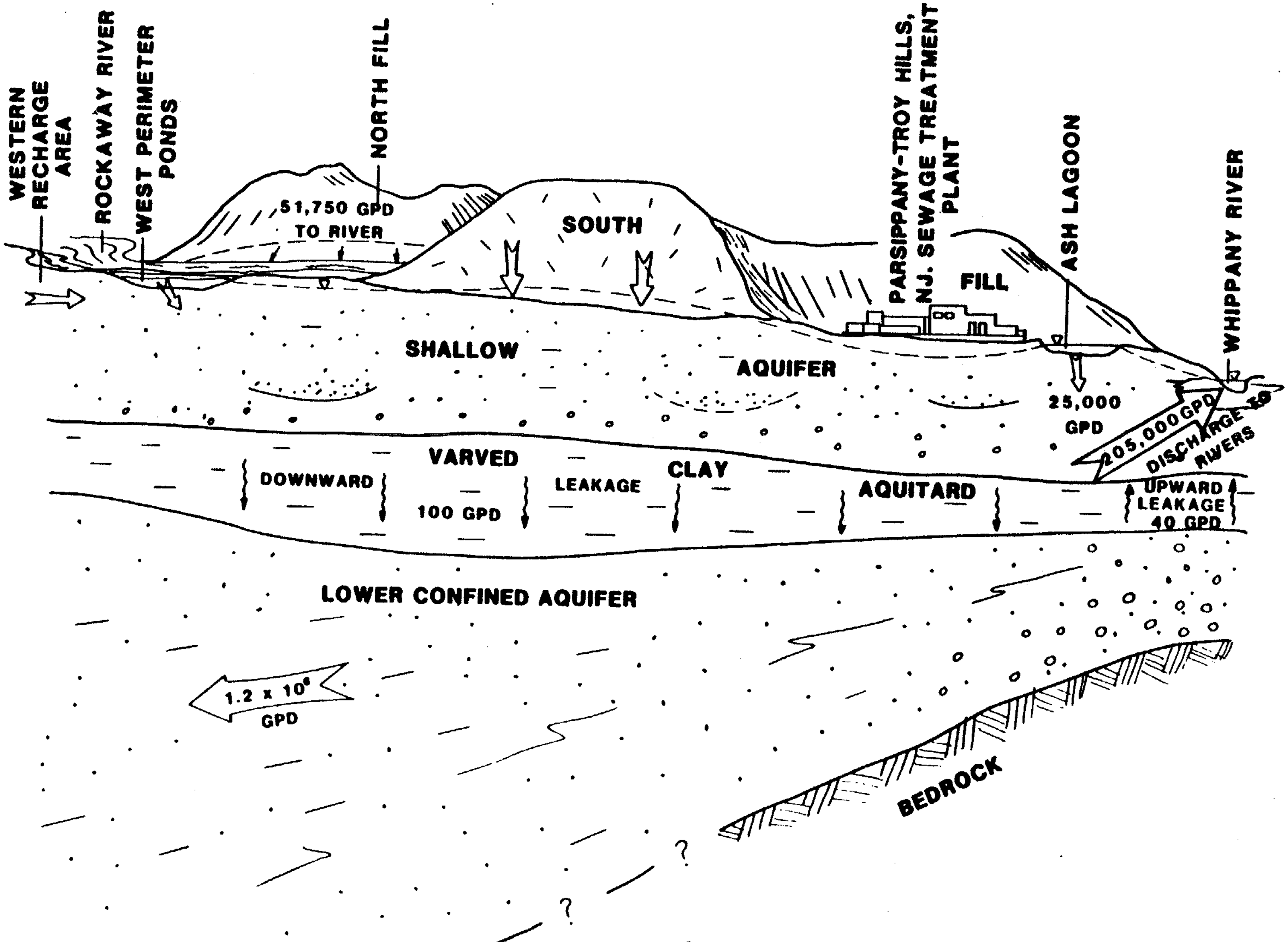

FIGURE 2.5-3

SCHEMATIC OF SHARKEY LANDFILL GROUNDWATER FLOW SYSTEM-SHOWING HYDROLOGIC BUDGET

Seasonal and long-term variations in these flow rates will occur due to climatological changes. Locally, precipitation events will result in short-term increases in the rate of discharge from the shallow aquifer. Conversely, prolonged periods of drought will result in diminished groundwater discharges from the shallow aquifer.

3.0 FIELD INVESTIGATIONS - CHEMICAL CHARACTERIZATION OF THE SITE

3.1 Groundwater Sampling

A groundwater sampling program was completed to characterize the chemical contamination present beneath the site and in nearby wells. Each of the 26 monitoring wells installed for this RI/FS were sampled. In addition, one public water supply well and six residential or commercially used wells in the vicinity of the landfill were sampled.

3.1.1 Field and Trip Blank Analyses

Volatile organic analyses were conducted on trip blanks submitted for each day that groundwater sampling was conducted. These blanks were prepared and sealed in the lab, remained sealed in the field and accompanied a field crew during sampling. The blanks were shipped on ice with the collected groundwater samples. In addition, a field blank associated with the monitoring well sampling was also prepared. This blank was prepared by decanting laboratory-provided deionized water into a decontaminated stainless steel bailer, and transferring the water from the bailer to sample bottles and vials.

The results of analyses for volatile organic compounds for each of the trip blanks and the monitoring well sampling field blank are provided on Table 3-1. Also shown, are the results of semi-volatile organic compounds analysis for the field blank. Low levels (4-6 ug/l) of methylene chloride were detected in each of these samples. Tetrachloroethylene (PCE) was found in one trip blank and the monitoring well field blank. In addition, chloroform and carbon disulfide were noted in the analyses of two trip blanks. With regard to semi-volatile organic compounds, bis (2-ethylhexyl)-phthalate and benzo (a) pyrene were found in the

Table 3-1
SHARKEY LANDFILL
Summary of Organic Compounds and Pesticides
On Field and Trip Blanks - Monitoring Well Sampling

Volatile Organic Compound	Trip Blanks 11/5/85	Trip Blanks 11/6/85	Trip Blanks 11/7/86	Field Blank Monitoring Wells 11/6/85
Chloroform (PP)			2 J	
Methylene Chloride (PP)	4 JB	6	4 JB	4 J
Tetrachloroethene (PP)			2 J	3 J
Carbon Disulfide		6 J		
Semi-Volatile Organic Compounds	N.A.	N.A.	N.A.	
bis(2 ethylhexyl)phthalate(PP)				12 J
Benzo(a)Pyrene (PP)				6 JB
Tentatively Identified Organic Compounds	None	None	None	None
Pesticides	None	None	None	None

Notes: Data Reporting Qualifiers

B - The analyte was found in the blank as well as the sample. It indicates possible/probable contamination and warns the data user to take appropriate action.

J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1 : 1 response is assumed or when the mass spectral data indicated the presence of a compound that meets identification criteria but the result less than the specified detection limit but greater than zero (e.g. if limit of detection is 10 ug/l and a concentration of 3 ug/l is calculated report as 3J).

(PP) - Priority Pollutant

. - All results in ug/l

N.A. - No analysis

N.R. - No report

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monitoring well field blank at 12 ug/l and 6 ug/l respectively. No semi-volatile analyses were conducted on the trip blanks.

Inorganic compound analysis conducted on the monitoring well field blank indicated positive detection of aluminum at 1130 ug/l, cyanide at 108 ug/l and zinc at 26 ug/l. Also found were potassium, sodium and vanadium. A copy of the laboratory report for these analyses is included in Appendix C-2.

The identification of the above organic and inorganic compounds in groundwater samples should be considered questionable, and possibly a result of laboratory procedures.

3.1.2 Sampling of Monitoring Wells

3.1.2.1 Method - On November 5, 6, and 7, 1985, each of the 26 monitoring wells constructed as part of this investigation were sampled for groundwater chemistry analysis. Prior to sampling, each well was purged with a submersible pump until a minimum of three and a maximum of five calculated well volumes were removed. During purging, specific conductance and pH variability changes were monitored. Less than 5% fluctuation of the above parameters over five minute sampling intervals was considered sufficient well stabilization, prior to sampling. However, removal of five well volumes was considered the maximum to be removed from any well prior to sampling. During well evacuation, the submersible pump was moved up and down the entire submerged distance in the well to insure that all water in the well was being flushed.

When well purging was completed, the pump was removed. Groundwater samples were then collected using a well dedicated stainless steel bailer, lowered with new, nylon line. Bailers were laboratory decontaminated in accordance with the provisions of Section 6.0 of the FSP. Sample collection, storage, preservation and chain-of-custody procedures were followed, also as described in the FSP. Samples were transported to the laboratory on the morning following the date of collection. In the interim, however, the samples were sealed in ice chests and locked securely in the command post until transported to the laboratory.

Sampling of the monitoring wells was performed by REWAI. Quality assurance supervision of procedures was provided by HydroQual, Inc. A copy of the master sample log associated with this sampling is provided as Appendix C-1. Chain-of-Custody forms and laboratory reports on individual sample analyses are provided with the separately submitted laboratory report package. Field analyses, including pH, specific conductance, and temperature were performed on representative groundwater samples at each sampling location at the time of sample collection. The results of these field analyses are included in the Master Sample Log, in Appendix C-1.

Laboratory priority pollutant (pp + 40) analysis was conducted on each groundwater sample collected. Analyses were conducted by U. S. Testing, Inc. of Hoboken, NJ. Quality assurance review of laboratory procedures and QA/QC results was performed by HydroQual, Inc. The results of this review is included in the Task 3 Interim Report entitled "Wet Weather Survey Results, Surface Water and Leachate" submitted separately by HydroQual, Inc., dated January 1986.

3.1.2.2 <u>Results Shallow Aquifer Monitoring Wells</u> - A summary of the positive analysis results for identifiable priority pollutant organic compounds in the shallow aquifer monitoring wells is shown on Table 3-2.

As shown on Table 3-2, the concentrations of contaminants observed is remarkably low. The diversity of compounds identified, at least in the priority pollutant category, is also very limited. The compounds found in the field and trip blank analyses (Section 3.1.1) have been deleted from this summary on Table 3-3. Shallow monitoring wells where identifiable organic compounds have not been found have also been ommitted on Table 3-3.

As shown on Table 3-3, Well WS-11, near the center of the North Fill, has the highest total concentrations for both volatile and semi-volatile organic compounds. The combined total of organic compounds is 269 micrograms per liter (ug/l). Water pumped from Well WS-11 during the pre-sampling purging process ranged in color from dark green to amber, and had a tendency to foam at the surface. The bailed samples were very murky, had a slight sheen on the surface, and left a "greasy" film on the stainless steel bailer used in the sampling. The sample temperature was recorded in the field at 30° C; the specific conductivity was measured at 25,000 umhos/cm (the highest reported during sampling); the pH was 7.83.

Toluene (73 ug/l) and ethylbenzene (42 ug/l) appear to be only volatile organic compounds identified in Well WS-11. Methylene chloride was also found in this well at a concentration of 32 ug/l (Table 3-2); however, this compound was also found in each of the field and trip blanks. Toluene (14 ug/l) and ethylbenzene (27 ug/l) were also identified in the shallow

TABLE 3-2

SHARKEY LANDFILL
November, 1985 Chemical Analyses
Identified Organic Compounds - Shallow Monitoring Wells

Monitoring Well/Concentration (ug/l)

Volatile Organic Compound	WS-1	WS-2	WS-3	WS-4	WS-5	WS-6	WS-7	WS-8	WS-9	WS-11	WS-12	WS-13	WS-14	WS-17
Chlorobenzene (PP)					23	75			17		18			
Chloroform (PP)												34		
Methylene Chloride (PP)					3 JB			2 JB	3 JB	32 B	4 JB	2 JB		
Trichloroethene (PP)						13								
Benzene (PP)					28	6					5	22		4 J
Tetrachloroethene (PP)						3 J	3 J	3 J	3 J		1 J			
Toluene (PP)									14	73				
Ethylbenzene (PP)						1 J			27	42				
Carbon Disulfide	15													
Total Xylenes											22	21		
Acetone		7 J												
Total Volatiles	15	7			54	98	3	5	64	147	50	79		4
Semi-Volatile Organic Compounds														
2,4-Dimethylphenol (PP)									70					
1,4-Dichlorobenzene (PP)						6 J						6 J		
4-Methylphenol										74	20 J			
2-Methylphenol											27 J			
bis(2 ethylhexyl)phthalate(PP)	2 JB	7 J	2 J	2 JB	6 JB	16 J			14 JB	120 B	13 JB	36 B	16 JB	4 J
Naphthalene (PP)				2 J	70 J	2 J			42	80	27 J	6 J		2 J
Benzo(a)Pyrene (PP)	8 JB			8	8	10 JB					27 JB			
4-chloro-3-Methylphenol					22									
2-Methylnaphthalene					80						87			
Total Semi-Volatiles	10	7	2	12	186	34			126	274	201	48	16	6
Combined Totals	25	14	2	12	240	132	3	5	190	421	251	127	16	10

Notes: Data Reporting Qualifiers

B - The analyte was found in the blank as well as the sample. It indicates possible/probable contamination and warns the data user to take appropriate action.

J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1 : 1 response is assumed or when the mass spectral data indicated the presence of a compound that meets identification criteria but the result less than the specified detection limit but greater than zero (e.g. if limit of detection is 10 ug/l and a concentration of 3 ug/l is calculated report as 3J).

(PP) - Priority Pollutant

TABLE 3-3

SHARKEY LANDFILL
November, 1985 Chemical Analyses
Adjusted Summary of Identified Organic Compounds - Shallow Monitoring Wells

Monitoring Well/Concentration (ug/l)

Volatile Organic Compound	WS-2	WS-3	WS-4	WS-5	WS-6	WS-7	WS-8	WS-9	WS-11	WS-12	WS-13	WS-17
Chlorobenzene (PP)				23	75			17		18		
Trichloroethene (PP)					13							
Benzene (PP)				28	6					5	22	4 J
Toluene (PP)								14	73			
Ethylbenzene (PP)					1 J			27	42			
Total Xylenes										22	21	
Acetone	7 J											
Total Volatiles	7			51	95			58	115	40	41	4
Semi-Volatile Organic Compounds												
2,4-Dimethylphenol (PP)								70				
1,4-Dichlorobenzene (PP)					6 J						6 J	
4-Methylphenol									74	20 J		
2-Methylphenol										27 J		
Naphthalene (PP)			2 J	70	2 J			42	80	27 J	6 J	2 J
4-chloro-3-Methylphenol				22								
2-Methylnaphthalene				80						87		
Total Semi-Volatiles			2	172	8			112	154	161	12	2
Combined Totals	7		2	223	103			170	269	201	53	6

Notes: Data Reporting Qualifiers

B - The analyte was found in the blank as well as the sample. It indicates possible/probable contamination and warns the data user to take appropriate action.

J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1 : 1 response is assumed or when the mass spectral data indicated the presence of a compound that meets identification criteria but the result less than the specified detection limit but greater than zero (e.g. if limit of detection is 10 ug/l and a concentration of 3 ug/l is calculated report as 3J).

(PP) - Priority Pollutant

*Compounds identified in laboratory analyses of field and trip blanks have been omitted.

groundwater sample from Well WS-9, located on the northern end of the North Fill. Chlorobenzene (17 ug/l) was also found in WS-9.

Shallow Monitoring Wells WS-12 and WS-13 are located on the southern end of the North Fill. Both of these wells are characterized by the presence of benzene and xylenes in the shallow groundwater (Table 3-3). Chlorobenzene was found in Well WS-12 in concentrations similar to Well WS-9.

Chloroform was reported in Well WS-13 (Table 3-2) at a concentration of 34 ug/l. This compound was also found in a trip blank (Table 3-1), and therefore, not noted on Table 3-3. In view of the concentration suggested on Table 3-2, the potential of the presence of this contaminant in Well WS-13 should be recognized.

Benzene and chlorobenzene were also found in the shallow aquifer at Sites WS-5, on the Northwest Fill, and WS-6 on the southwest flank of the South Fill. Trichloroethylene (TCE), at 13 ug/l, and ethylbenzene (1 ug/l) were also found at Site WS-6. TCE was not found in any other shallow aquifer well location on site.

Naphthalene appears to be the most commonly identified semi-volatile compound on site. As shown on Table 3-3, it has been found at each well on the North Fill (WS-9, 11, 12, and 13) in concentrations ranging from 6 ug/l to 8Ø ug/l. This compound was also identified in Well WS-5, on the Northwest Fill, at 7Ø ug/l, in association with 2-methyl naphthalene (also found in Well WS-12) and 4-chloro-3 methlyphenol (22 ug/l).

Results of analyses conducted on the shallow aquifer monitoring well samples for inorganic chemical species are shown on

Table 3-4. The EPA Interim Primary and Secondary Drinking Water Standards are also shown on this table.

Most notable on Table 3-4 are relatively high concentrations of iron, chromium, and magnesium throughout all the samples. The samples were not filtered prior to analysis. This could account partially for the high metals content of the samples.

Aluminum, vanadium and manganese concentrations also appear high. However, this data is consistently flagged as questionable due to laboratory interferences. Therefore, the information should not necessarily be included in site evaluations.

Cyanide was found in Wells WS-3 (248 ug/l) and WS-6 (15 ug/l), and in the groundwater sampling field blank (108 ug/l). Laboratory re-analysis of the field blank samples was performed and no cyanide was detected. Although the sample holding time was exceeded at the time of re-analysis, the sample was preserved for cyanide and the compound should have been detected, if initially present. The detection of cyanide in the samples and the field blank therefore remains questionable. Phenol was reportedly found in each shallow well with the exceptions of Wells WS-1, WS-7 and WS-8. The range of concentrations for this compound where detected were 16 ug/l to 275 ug/l. Well WS-11 revealed the highest reported concentration.

A list of tentatively identified or unidentifiable organic compounds found in shallow well samples is provided on Table 3-5. A summary of total volatile and semi-volatile compound concentrations for each well from this list is provided on Table 3-6.

Table 3-4
Sharkey Landfill November 1985
Identified Inorganic Compounds
Shallow Monitoring Wells

Sample Location			WS-1	WS-2	WS-3	WS-4	WS-5	WS-6	WS-7
Sample Code			4886-C	4886-EE	4886-II	4886-F	4886-G	4886-W	4886-L
INORGANICS	I.P.S**	NJS							
Aluminum			21200 E	2070 E	20800 E	59800 E	5560 E	27900 E	9960 E
Antimony		146							
Arsenic	50		15			15 R		8.3 []	9.9 []
Barium	1000		159 []	285 R	227 R	597	275	172 []R	161 []
Beryllium		0.0037	1.8 []		2.7 []	2.4 []		3.1 []	
Cadmium	10	10		11 *	8.4 *	6.2 ER		13 *	
Calcium			50300	118000	93500	63900	73200	200000	55300
Chromium	50	50	77		54	341	6.8 []	4990	24
Cobalt			16 []		41 []	45 []		19 []	16 []
Copper	1000		101		322	181	10 []	300	67
Iron	300		75600	6350 ER	68500 ER	185000	26800	47000 ER	35100
Lead	50	50			290 R	81 R	9	63 R	29
Cyanide	50	200			248			15	
Magnesium			27900	42400 E	35300 E	51000	49700	32800 E	22200
Manganese	50		1380 E	1490 E	1550 E	7480 E	244 E	1490 E	2570 E
Mercury	2	0.144	0.1 []	0.1 []	1	1	0.1 []	0.1 []	0.1 []
Nickel		13.4	52		172 R	246		87 R	63
Potassium			5580	31800	28900	7930	59900	19500	7080 E
Selenium	10	50							
Silver	50								
Sodium			14600	112000 E	37400 E	20000	58000	178000 E	40500
Thallium									
Tin									
Vanadium			119 E	122 E	170 E	230 E	85 E	57 E	68
Zinc			184 E*	109	1110	608 E*	180 E*	477	99
Percent Solids			NA	NA	NA	NA	NA	NA	NA
Phenol				69	22	41	33	22	

Pesticides (none)

Notes:

** -- EPA Interim Primary and Secondary Drinking Water Standards (1981-1982) in UG/L.
[] = If the result is a value greater than or equal to the instrument detection limit but less than the contract required detection limit, report the value in brackets.
_ = Compounds underlined exceed I.P.S.** or N.J.S.
E = Indicates a value estimated or not reported due to the presence of interference.
1059 SHA 001 ---tes spike sample recovery is not within control limits.
--cate analysis is not within control limits.
n UG/L
NJS - .. nt Discharge elimination System (NJPDES) Regulations, October 1984.

Table 3-4
Sharkey Landfill November 1985
Identified Inorganic Compounds
Shallow Monitoring Wells

Sample Location Sample Code			WS-8 4886-P	WS-9 4886-BB	WS-11 4886-DD	WS-12 4886-GG	WS-13 4886-CC	WS-14 4886-K	WS-17 48886-HH
INORGANICS	I.P.S**	NJS							
Aluminum			20900 E	31500 E	29300 E	3670 E	56500 E	12800 E	11300 E
Antimony		146							
Arsenic	50				24				
Barium	1000		203	549	684	219	1440	140 []	566 R
Beryllium		0.0037		2.8 []	1.7 []		2.9 []		
Cadmium	10	10		7.4	5.3		4.1 []		8.1 *
Calcium			63100	33800	38800	54600	195000	71000	68400
Chromium	50	50	48	146	334	75	182	89	34
Cobalt			29 []	66	126	23 []	84	14 []	10 []
Copper	1000		80	134	183	32	191	46	66
Iron	300		83400	74300	67800	35900	101000	33700	69300 ER
Lead	50	50	4.8 []	480		77	14	25	145 ER
Cyanide	50	200							
Magnesium			42100	67900	81200	64200	134000	39100	35000 E
Manganese	50		1720 E	1240 E	829 E	258 E	4860 E	1160 []E	299 E
Mercury	2	0.144	0.1 []	1.6	0.1 []	0.1 []	0.1 []	0.1 []	0.1 []
Nickel		13.4	60	564	1390	320	405	60	41 R
Potassium			35600 E	486000 E	1100000 E	197000 E	192000 E	3780 []E	29900
Selenium	10	50							
Silver	50								
Sodium			55300	1820000	3560000	617000	6910000	37300	46800 E
Thallium									
Tin									
Vanadium			113	108	339	12 []	302	62	105 E
Zinc			159	2620	1140	229	388	93	196
Percent Solids			NA	NA	NA	NA	NA	NA	NA
Phenol				23	275	24	28	16	76

Pesticides (none)

Notes:

** -- EPA Interim Primary and Secondary Drinking Water Standards (1981-1982) in UG/L.
[] = If the result is a value greater than or equal to the instrument detection limit but less than the contract required detection limit, report the value in brackets.
. = Compounds underlined exceed I.P.S.** or N.J.S.
E = Indicates a value estimated or not reported due to the presence of interference.
R = Indicates spike sample recovery is not within control limits.
* = Indicates duplicate analysis is not within control limits.
. = All results are in UG/L
NJS = New Jersey Polluant Discharge elimination System (NJPDES) Regulations, October 1984.

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Table 3-5
Sharkey Landfill, November 1985
Tentatively Identified Organic Compounds
Shallow Monitoring Wells

Well	Sample Number	Fraction	Compound Name	Scan Number	Estimated (UG/L) Concetration
WS-01	4886-C	VOA	NONE DETECTED	0	0
WS-01	4886-C	ABN	NONE DETECTED	0	0
WS-02	4886-EE	ABN	NONE DETECTED	0	0
WS-02	4886-EE	VOA	UNKNOWN	355	11
WS-02	4886-EE	VOA	UNKNOWN	957	5
WS-03	4886-II	VOA	NONE DETECTED	0	0
WS-03	4886-II	ABN	UNKNOWN	194	280
WS-04	4886-F	VOA	NONE DETECTED	0	0
WS-04	4886-F	ABN	UNKNOWN	191	20
WS-04	4886-F	ABN	UNKNOWN	228	14
WS-04	4886-F	ABN	UNKNOWN	990	15
WS-04	4886-F	ABN	UNKNOWN	1148	9
WS-04	4886-F	ABN	UNKNOWN	1226	55
WS-04	4886-F	ABN	UNKNOWN	1534	14
WS-05	4886-G	VOA	UNKNOWN	0	0
WS-05	4886-G	ABN	UNKNOWN	191	13
WS-05	4886-G	ABN	CHLOROBENZENE	395	12
WS-05	4886-G	ABN	UNKNOWN	747	9
WS-05	4886-G	ABN	UNKNOWN	852	12
WS-05	4886-G	ABN	UNKNOWN	895	11
WS-05	4886-G	ABN	UNKNOWN	911	19
WS-05	4886-G	ABN	UNKNOWN	964	35
WS-05	4886-G	ABN	UNKNOWN	1090	17
WS-05	4886-G	ABN	UNKNOWN	1323	60
WS-05	4886-G	ABN	UNKNOWN	1377	16
WS-05	4886-G	ABN	UNKNOWN	1390	32
WS-05	4886-G	ABN	PHOSOPHORCACIDTRIBUTYL ESTER	1456	16
WS-05	4886-G	ABN	UNKNOWN	1517	16
WS-05	4886-G	ABN	UNKNOWN	1593	56
WS-05	4886-G	ABN	UNKNOWN	1605	31
WS-05	4886-G	ABN	UNKNOWN	1867	16
WS-05	4886-G	ABN	UNKNOWN	2042	9
WS-06	4886-W	VOA	UNKNOWN	339	12
WS-06	4886-W	VOA	UNKNOWN	994	13
WS-06	4886-W	ABN	UNKNOWN	403	29
WS-06	4886-W	ABN	UNKNOWN	2026	12
WS-06	4886-W	ABN	UNKNOWN	2096	14
WS-06	4886-W	ABN	UNKNOWN	2158	9
WS-06	4886-W	ABN	UNKNOWN	2195	25
WS-06	4886-W	ABN	UNKNOWN	2217	31
WS-06	4886-W	ABN	UNKNOWN	2275	25
WS-07	4886-L	VOA	UNKNOWN	1146	27
WS-07	4886-L	ABN	UNKNOWN	193	23
WS-08	4886-P	VOA	NONE DETECTED	0	0
WS-08	4886-P	ABN	NONE DETECTED	0	0
[illegible]	[illegible]	[illegible]	TETRAHYDROFURAN	438	7
[illegible]	[illegible]	[illegible]	UNKNOWN	445	7
[illegible]	[illegible]	[illegible]	TRIMETHYL SILANOL	536	14

Table 3-5
Sharkey Landfill, November 1985
Tentatively Identified Organic Compounds
Shallow Monitoring Wells

Well	Sample Number	Fraction	Compound Name	Scan Number	Estimated (UG/L) Concetration
WS-09	4886-BB	VOA	UNKNOWN	642	8
WS-09	4886-BB	VOA	2,4-DIMETHYL-3-PENTAMANE	808	8
WS-09	4886-BB	VOA	UNKNOWN	924	7
WS-09	4886-BB	VOA	UNKNOWN	1115	32
WS-09	4886-BB	VOA	UNKNOWN	1157	21
WS-09	4886-BB	ABN	UNKNOWN	191	67
WS-09	4886-BB	ABN	UNKNOWN	208	40
WS-09	4886-BB	ABN	UNKNOWN	361	44
WS-09	4886-BB	ABN	DIMETHYL BENZENE	499	27
WS-09	4886-BB	ABN	UNKNOWN	943	190
WS-09	4886-BB	ABN	UNKNOWN	1008	44
WS-09	4886-BB	ABN	UNKNOWN	1027	53
WS-09	4886-BB	ABN	UNKNOWN	1127	71
WS-09	4886-BB	ABN	UNKNOWN	1140	80
WS-09	4886-BB	ABN	(2-METHYL-1-PROPENYL)BENZENE	1672	140
WS-09	4886-BB	ABN	UNKNOWN	1748	1440
WS-09	4886-BB	ABN	UNKNOWN	1889	50
WS-11	4886-DD	VOA	UNKNOWN	442	25
WS-11	4886-DD	VOA	UNKNOWN	456	58
WS-11	4886-DD	VOA	TRIMETHYL SILANOL	538	62
WS-11	4886-DD	VOA	DIFLUOROBENZENE	699	67
WS-11	4886-DD	VOA	UNKNOWN	801	14
WS-11	4886-DD	VOA	UNKNOWN	351	14
WS-11	4886-DD	VOA	UNKNOWN	923	51
WS-11	4886-DD	VOA	UNKNOWN	1024	55
WS-11	4886-DD	VOA	UNKNOWN	1120	36
WS-11	4886-DD	VOA	UNKNOWN	1162	57
WS-11	4886-DD	ABN	UNKNOWN	205	130
WS-11	4886-DD	ABN	UNKNOWN	275	48
WS-11	4886-DD	ABN	UNKNOWN	409	120
WS-11	4886-DD	ABN	UNKNOWN	886	100
WS-11	4886-DD	ABN	UNKNOWN	1209	440
WS-11	4886-DD	ABN	UNKNOWN	1276	316
WS-11	4886-DD	ABN	UNKNOWN	1359	150
WS-11	4886-DD	ABN	UNKNOWN	1380	72
WS-11	4886-DD	ABN	UNKNOWN	1453	72
WS-11	4886-DD	ABN	UNKNOWN	1537	32
WS-11	4886-DD	ABN	UNKNOWN	1679	48
WS-11	4886-DD	ABN	UNKNOWN	1790	290
WS-11	4886-DD	ABN	UNKNOWN	1866	76
WS-11	4886-DD	ABN	UNKNOWN	1932	96
WS-11	4886-DD	ABN	UNKNOWN	2051	25
WS-11	4886-DD	ABN	UNKNOWN	2090	62
WS-11	4886-DD	ABN	UNKNOWN	2120	25
[illegible]	[illegible]	[illegible]	UNKNOWN	2165	22
[illegible]	[illegible]	[illegible]	UNKNOWN	2252	22
[illegible]	[illegible]	[illegible]	UNKNOWN	2283	80
[illegible]	[illegible]	[illegible]	UNKNOWN	2815	36

Table 3-5
Sharkey Landfill, November 1985
Tentatively Identified Organic Compounds
Shallow Monitoring Wells

Well	Sample Number	Fraction	Compound Name	Scan Number	Estimated (UG/L) Concetration
WS-11	4886-DD	ABN	UNKNOWN	2379	105
WS-11	4886-DD	ABN	UNKNOWN	2667	60
WS-12	4886-GG	VOA	CHLORODIFLUOROMETHANE	511	11
WS-12	4886-GG	VOA	TRETRAHYDROFURAN	438	60
WS-12	4886-GG	VOA	TRIMETHYL SILANOL	536	20
WS-12	4886-GG	VOA	UNKNOWN	1153	8
WS-13	4886-CC	VOA	1-PROPENE	120	9
WS-13	4886-CC	VOA	TETRAHYDROFURAN	438	22
WS-13	4886-CC	VOA	UNKNOWN	446	30
WS-13	4886-CC	VOA	UNKNOWN	468	13
WS-13	4886-CC	VOA	TRIMETHYL SILANOL	536	24
WS-13	4886-CC	VOA	UNKNOWN	1156	7
WS-13	4886-CC	ABN	UNKNOWN	191	63
WS-13	4886-CC	ABN	UNKNOWN	202	136
WS-13	4886-CC	ABN	UNKNOWN	214	21
WS-13	4886-CC	ABN	UNKNOWN	414	31
WS-13	4886-CC	ABN	UNKNOWN	449	25
WS-13	4886-CC	ABN	DIMETHYL BENZENE	500	21
WS-13	4886-CC	ABN	UNKNOWN	591	13
WS-13	4886-CC	ABN	UNKNOWN	640	13
WS-13	4886-CC	ABN	UNKNOWN	750	23
WS-13	48860CC	ABN	UNKNOWN	830	56
WS-13	4886-CC	ABN	4-METHYL-BENZENAMINE HYDROCHLORIDE	842	33
WS-13	488-CC	ABN	UNKNOWN	930	16
WS-13	4886-CC	ABN	UNKNOWN	1122	38
WS-13	4886-CC	ABN	UNKNOWN	1397	22
WS-13	4886-CC	ABN	UNKNOWN	1450	37
WS-13	4886-CC	ABN	UNKNOWN	1520	42
WS-13	4886-CC	ABN	UNKNOWN	1655	34
WS-13	4886-CC	ABN	UNKNOWN	1689	36
WS-13	4886-CC	ABN	UNKNOWN	1727	150
WS-13	4886-CC	ABN	UNKNOWN	1910	102
WS-13	4886-CC	ABN	UNKNOWN	1950	38
WS-13	4886-CC	ABN	UNKNOWN	2070	18
WS-13	4886-CC	ABN	UNKNOWN	2093	74
WS-13	4886-CC	ABN	UNKNOWN	2134	22
WS-13	4886-CC	ABN	UNKNOWN	2243	22
WS-14	4886-K	VOA	TETRAHYDROFURAN	440	9
WS-14	4886-K	VOA	TRIMETHYL SILANOL	537	7
WS-14	4886-K	VOA	1-BROM-3-FLOUROBENZENE	1017	13
WS-14	4886-K	VOA	UNKNOWN	677	39
WS-14	4886-K	VOA	UNKNOWN	788	63
WS-14	4886-K	VOA	UNKNOWN	914	12
WS	[illegible]	[illegible]	[illegible]WN	1087	46
WS	[illegible]	[illegible]	[illegible]WN	1134	10
WS	[illegible]	[illegible]	[illegible]N	1188	7
WS	[illegible]	[illegible]	[illegible]JWN	191	38
WS-17	4886-HH	ABN	UNKNOWN	213	21

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Table 3-5
Sharkey Landfill, November 1985
Tentatively Identified Organic Compounds
Shallow Monitoring Wells

Well	Sample Number	Fraction	Compound Name	Scan Number	Estimated (UG/L) Concetration
WS-17	4886-HH	ABN	(1,1-DIMETHYLETHYL)PHENOL	1131	10
WS-17	4886-HH	ABN	5-METHYL-2-(1-METHYLETHYL)PHENOL	1160	68
WS-17	4886-HH	ABN	5-METHYL-2-(1-METHYLETHYL)PHENOL	1178	18
WS-17	4886-HH	ABN	UNKNOWN	1519	25
WS-17	4886-HH	ABN	UNKNOWN	1579	12
WS-17	4886-HH	ABN	UNKNOWN	1596	24
WS-17	4886-HH	ABN	UNKNOWN	1938	59
WS-17	4886-HH	ABN	UNKNOWN	2125	13
WS-17	4886-HH	VOA	UNKNOWN	994	10

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Table 3-6
Sharkey Landfill
Total Volatile and Semi-Volatile (ABN) Concentrations
Tentatively Identified Compounds
(Values in ug/l)

Wells	VOA Total	ABN Total
WS-1	0	0
WS-2	16	0
WS-3	0	280
WS-4	0	127
WS-5	0	380
WS-6	25	145
WS-7	27	23
WS-8	0	0
WS-9	104	2246
WS-11	439	2427
WS-12	99	0
WS-13	105	1086
WS-14	206	38
WS-17	10	250

3.1.2.3 Results - Lower Aquifer Monitoring Wells - A summary of identifiable organic compound analyses on (WI-) intermediate and (WD-) deep series monitoring well samples is provided on Table 3-7. Bolatile organic contamination was indicated in three wells; WI-7, WI-15 and WI-17. In view of the occurrence of chloroform, methylene chloride and tetrachloroethene in blank analyses (Section 3.1.1.3) it is probable that these low level detections in Wells WI-7, WI-15, and WI-17 are a laboratory or sampling function and not representative of the samples. Also, the recurrence of bis (2-ethylhexyl) phthalate and benzo (a) pyrene is probably laboratory induced. With the elimination of these latter two compounds, semi-volatile contamination is not present in the lower glacial outwash aquifer.

With the elimination of laboratory or field induced contaminants from Table 3-7, Well WI-17 remains the only lower aquifer well where identifiable volatile organic contamination is present. Included in the compounds identified are benzene (13 ug/l) and acetone (8 ug/l). Acetone was also detected in Well WS-2, at a concentration of approximately 7 ug/l. It was not found in any other well on-site. Benzene was found in two shallow wells on the North Fill; WS-12 and WS-13, and also in Wells WS-5, WS-6 and WS-17 in the South Fill area.

A summary of results of laboratory analyses for inorganic chemicals in samples from the intermediate and deep monitoring wells is provided on Table 3-8. EPA Interim Primary and Secondary Drinking Water Standards are also listed to evaluate the relative levels of these contaminants. As shown, high levels of iron and manganese are common to all intermediate wells. Manganese levels meet drinking water standards in only two wells, WI-5 and WI-16.

TABLE 3-7

SHARKEY LANDFILL
November, 1985 Chemical Analyses
Identified Organic Compounds - Intermediate and Deep Monitoring Wells
Lower Glacial Outwash Aquifer
Monitoring Well/Concentration (ug/l)

Volatile Organic Compound	WD-2	WI-3	WD-3	WI-4	WI-5	WI-6	WI-7	WI-8	WI-10	WI-15	WI-16	WI-17
Chloroform												2
Methylene Chloride							3 J					
Benzene										3 J		13
Tetrachloroethene												3
Acetone												8
Semi-Volatile Organic Compounds												
bis(2 ethylhexyl)phthalate				2 JB	4 JB	2 J	2 J	6 JB	2 JB	2 JB	7 JB	
Benzo(a)Pyrene		8 JB			8 JB		8 JB	8 JB	8 JB	27 JB		

Pesticides

None

Notes: Data Reporting Qualifiers

B - The analyte was found in the blank as well as the sample. It indicates possible/probable contamination and warns the data user to take appropriate action.

J - Indicates an estimated value. This flag is used either when estimating a concentraion for tentatively identified compounds where a 1 : 1 response is assumed or when the mass spectral data indicated the presence of a compound that meets identification criteria but the result less than the specified detection limit but greater than zero (e.g. if limit of detection is 10 ug/l and a concentration of 3 ug/l is calculated report as 3J).

- All results in ug/l.

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Table 3-8
Sharkey Landfill November 1985
Identified Inorganic Compounds
Intermediate and Deep Monitoring Wells

Sample Location			WI-7	WI-8	WI-10	WI-15	WI-16	WI-17
Sample Code			4886-T	4886-I	4886-E	4886-B	4886-A	4886-Q
INORGANICS	I.P.S**	NJS						
Aluminum			4740 E	4840 E	281000 E	4730 E	2070 E	8890 E
Antimony		146						66
Arsenic	50				43 R		9.5 []*	
Barium	1000		39 []	70 []	1280	206	51 []	
Beryllium	-	0.0037			13			
Cadmium	10	10	3 []*	6.8 ER	7.6 ER		19 ER	
Calcium			12500	40900	705000	181000	59800	83000
Chromium	50	50	16	18	492	7.6 []	5.8 []	206
Cobalt				8 []	307			12 []
Copper	1000		12 []	40	894		41	59
Iron	300		6100 ER	7680	580000	6690 R	2560	12700
Lead	50	50		24 R	31 R	5.3	15 R	
Cyanide	50	200						
Magnesium			5480 E	12400	338500	19200	12300	24200
Manganese	50		150 E	164 E	19900 E	367 E	20 E	429 E
Mercury	2	0.144	0.1 []	0.1 []	0.1 []	0.1 []	0.1 []	0.1 []
Nickel		13.4	16 []R	31 []	594			181
Potassium			16900	4400 []	28600	3420 []	5010	8780 E
Selenium	10	50						
Silver	50							
Sodium			76900 E	37000	96500	82200	67200	79700
Thallium								
Tin								
Vanadium			110 E	49 []E	867 E	56 E	30 []E	135
Zinc			60	206 E*	1480 ER	69 E*	70 E*	91
Percent Solids			NA	NA	NA	NA	NA	NA
Phenol			17	20	15		22	21
Pesticides	(none)							

Notes:

** -- EPA Interim Primary and Secondary Drinking Water Standards (1981-1982) in UG/L.
[] = If the result is a value greater than or equal to the instrument detection limit but less than the contract required detection limit. report the value in brackets.
...rlined exceed I.P.S.** or N.J.S.
...ue estimated or not reported due to the presence of interference.
... sample recovery is not within control limits.
* = ... cate analysis is not within control limits.
. = All results ... in UG/L

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Table 3-8
Sharkey Landfill November 1985
Identified Inorganic Compounds
Intermediate and Deep Monitoring Wells

Sample Location			WD-2	WI-3	WD-3	WI-4	WI-5	WI-6
Sample Code			4886-FF	4886-U	4886-JJ	4886-O	4886-N	4886-X
INORGANICS	I.P.S**	NJS						
Aluminum			11100 E	6010 E	155000 E	6660 E	2070 E	32300 E
Antimony		146						
Arsenic	50				45	8 []R	7.9 []R	
Barium	1000		82 []R	44 []R	337 R	44 []	35 []	190 []R
Beryllium		0.0037			7			3 []
Cadmium	10	10	25 *	3.9 []*	5.5 *	5.4 ER	8.3 ER	
Calcium			92400	22000	720000	11500	40200	25500
Chromium	50	50	17	68	143	21	24	97
Cobalt			11 []	4 []	173		4.1 []	18 []
Copper	1000		44	43	734	46		70
Iron	300		16400 ER	8080 ER	260000 ER	8930	2160	42800 ER
Lead	50	50	35 R	26 R	80 R			7.5 R
Cyanide	50	200						
Magnesium			28800 E	5010 E	297000 E	4290 []	11500	16700 E
Manganese	50		441 E	195 E	14700 E	225 E	23 E	916 E
Mercury	2	0.144	0.1 []	0.1 []	0.1 []	0.1 []	0.1 []	0.1 []
Nickel		13.4	39 []R	72 R	307 R	17 []		49 R
Potassium			8230	16300	23500	4710 []	4150 []	13500
Selenium	10	50						
Silver	50							
Sodium			79600 E	100000 E	91400 E	46600	40200	93800 E
Thallium								
Tin				110 []E				
Vanadium			83 E	130 E	442 E	83 E	68 E	132 E
Zinc			175	150	899	106 E*	47 E*	166
Percent Solids			NA	NA	NA	NA	NA	NA
Phenol			18	18	29	8		7
Pesticides	(none)							

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Notes:

** -- EPA Interim Primary and Secondary Drinking Water Standards (1981-1982) in UG/L.
[] = If the result is a value greater than or equal to the instrument detection limit but less than the contract required detection limit, report the value in brackets.
-- ...unds underlined exceed I.P.S.** or N.J.S.
...alue estimated or not reported due to the presence of interference.
...mple recovery is not within control limits.
...e analysis is not within control limits.
* Hi... ...n UG/L

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TØØ19Ø

Generally, metals concentrations are significantly lower in the intermediate wells when compared with counterpart shallow wells, as shown by inspection of Tables 3-4 and 3-8. With the possible exception of the anomalously high iron, magnesium and manganese concentrations noted in Wells WD-3 and WI-3, the highest concentrations of iron and magnesium found in all sampling was at Site WI-1Ø, far removed from the direct influence of the fill.

Phenol was detected in each of the lower aquifer wells except Wells WI-5 and WI-16. The phenol concentrations in the lower aquifer range between 7 and 29 ug/l, as shown on Table 3-8. A list of tentatively identified or unidentified organic compounds is shown on Table 3-9. Total concentrations of volatile and semi-volatile (ABN) fractions are also included for each well. Due to the questionable presence of these compounds, further discussion of these contaminants would be inapropriate without additional data.

3.1.3 Potable Well Investigation

Groundwater from six residential or commercial wells, and one public supply well was sampled and analyzed for chemical parameters. Four of the wells, designated RW-1Ø1, RW-2Ø3, RW-351, and RW-365, are residential wells; two wells RW-2Ø4 and RW-2Ø5, are used for commercial purposes; PW-3Ø5 is a public supply well located in East Hanover Township, referred to as t[illegible] Homestead Avenue well. It serves East Hanover Township.

The approximate location of each of these wells is shown [illegible] Figure 3.1-1. Table 3-1Ø provides a summary of results [illegible] chemical analyses for identifiable organic compounds in the[illegible]

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Table 3-9
Sharkev Landfill, November 1985
Tentatively Identified Organic Compounds
Intermediate and Deep Monitoring Wells

Well	Sample Number	Fraction	Compound Name	Scan Number	Estimated (UG/L) Concentration	Total VOA	Total ABN
WD-02	4886-FF	VOA	NONE DETECTED	0	0	0	0
WD-02	4886-FF	ABN	NONE DETECTED	0	0	0	0
WD-03	4886-JJ	VOA	NONE DETECTED	0	0	0	33
WD-03	4886-JJ	ABN	UNKNOWN	191	33	0	0
WI-03	4886-U	ABN	NONE DETECTED	0	0	0	0
WI-03	4886-U	VOA	NONE DETECTED	0	0	0	0
WI-04	4886-O	VOA	UNKNOWN	0	0	0	345
WI-04	4886-O	ABN	UNKNOWN	191	220	0	0
WI-04	4886-O	ABN	UNKNOWN	209	26	0	0
WI-04	4886-O	ABN	UNKNOWN	1005	19	0	0
WI-04	4886-O	ABN	UNKNOWN	1437	68	0	0
WI-04	4886-O	ABN	UNKNOWN	1614	12	0	0
WI-05	4866-N	VOA	NONE DETECTED	0	0	0	63
WI-05	4886-N	ABN	UNKNOWN	191	26	0	0
WI-05	4886-N	ABN	UNKNOWN	219	37	0	0
WI-06	4886-X	VOA	NONE DETECTED	0	0	0	0
WI-06	4886-X	ABN	NONE DETECTED	0	0	0	0
WI-07	4886-T	ABN	UNKNOWN	191	15	10	47
WI-07	4886-T	ABN	UNKNOWN	215	26	0	0
WI-07	4886-T	ABN	UNKNOWN	307	6	0	0
WI-07	4886-T	VOA	UNKNOWN	957	10	0	0
WI-08	4886-I	VOA	UNKNOWN	0	0	0	0
WI-08	4886-I	ABN	UNKNOWN	0	0	0	0
WI-10	4886-E	VOA	NONE DETECTED	0	0	0	10
WI-10	4886-E	ABN	UNKNOWN	194	10	0	0
WI-15	4886-B	VOA	NONE DETECTED	0	0	0	0
WI-15	4886-B	ABN	NONE DETECTED	0	0	0	0
WI-16	4886-A	VOA	NONE DETECTED	0	0	0	170
WI-16	4886-A	ABN	UNKNOWN	214	170	0	0
WI-17	4886-Q	VOA	1,4-DIOXO	536	8	8	477
WI-17	4886-Q	ABN	UNKNOWN	788	19	0	0
WI-17	4886-Q	ABN	UNKNOWN	1072	18	0	0
WI-17	4886-Q	ABN	UNKNOWN	1304	22	0	0
WI-17	4886-Q	ABN	UNKNOWN	1314	370	0	0
WI-17	4886-Q	ABN	UNKNOWN	1506	16	0	0
WI-17	4886-Q	ABN	UNKNOWN	1660	18	0	0
WI-17	4886-Q	ABN	UNKNOWN	1687	14	0	0

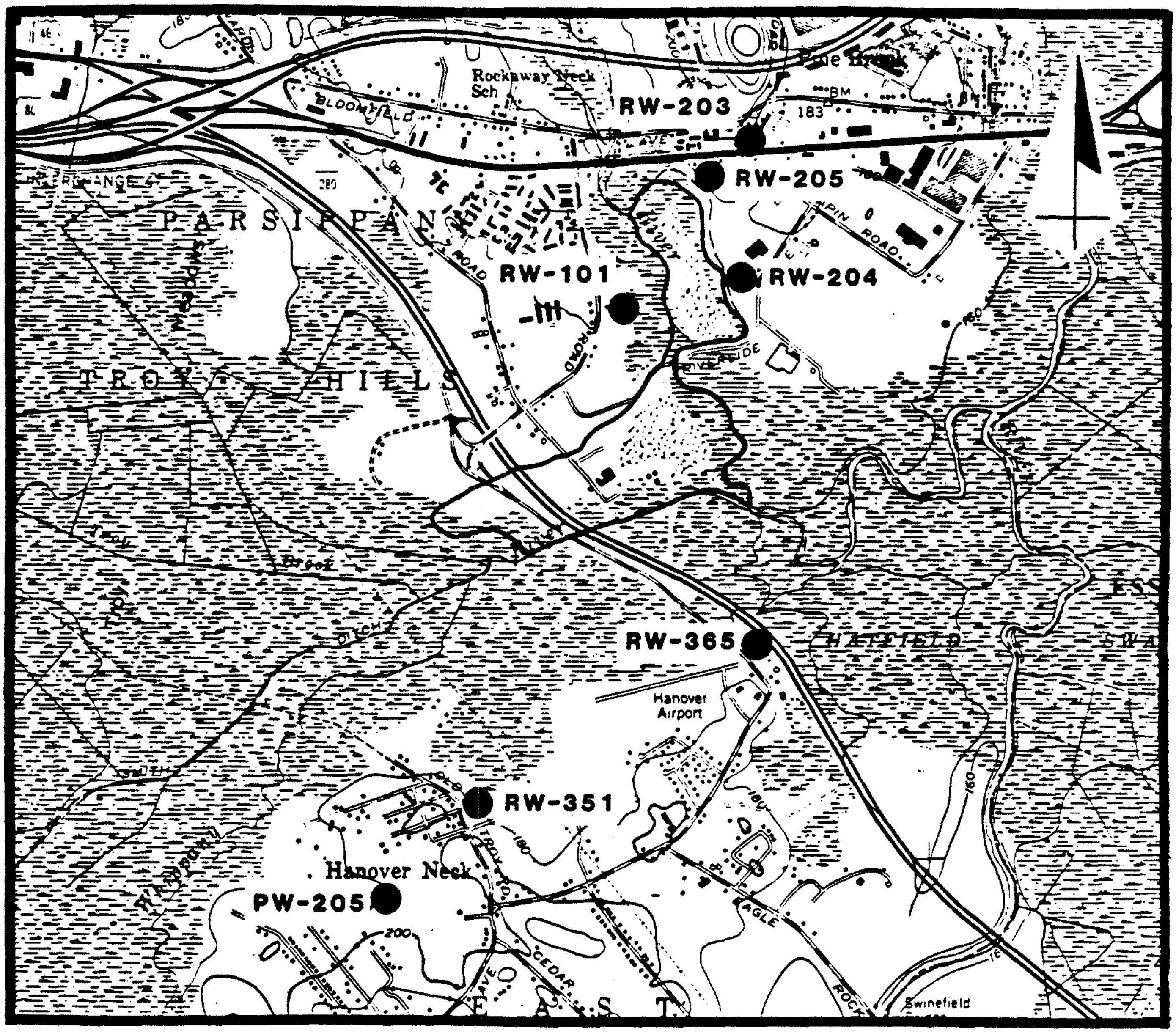

FIGURE 3.1-1

POTABLE WELL LOCATIONS

0 2000'
SCALE

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TABLE 3-10

Chemical Analyses
SHARKEY LANDFILL
November 1985, Chemical Analyses
Identified Organic Compounds - Potable Well Investigation

	Sample Location						
	RW-101	RW-203	RW-204	RW-351	RW-365	RW-205	RW-305
Well Type*	L	R	S	L	S	S	L
Well Depth	50	120	16	78	8	?	119
Chemical							
Bis (2-Ethylhexyl) Phalate	18JB	2JB	--	--	4JB	2JB	--
Benzo (a) Pyrene	8JB	8JB	--	10JB	--	8JB	8JB
Carbon Disulfide	--	--	--	--	--	--	21

J = Estimated Value
B = Found in Blank
*Inferred from depth of conpletion
S = Shallow Aquifer
L = Lower or Intermediate Aquifer
R = Bedrock Aquifer

samples. This table also indicates the assumed aquifer in which each well was completed.

Sampling was performed in accordance with the provisions of the FSP. Details associated with each sampling, including a completed presampling questionnaire for each site, is provided in the Master Sampling Log (Appendix C-1).

Whereas Bis (2-ethylhexyl) phthalate and Benzo (a) pyrene have been found in field blank analysis (Table 3-1), these are probably laboratory related. Carbon disulfide (21 ug/l) was found in PW-305. This compound was also found in one trip blank (Table 3-5) On the basis of these observations, none of the potable wells sampled appear to be adversely affected in terms of organic contamination. Reported concentrations are probably laboratory induced.

A summary of identified inorganic compounds in potable well samples is provided on Table 3-11. EPA Interim Primary and Secondary Drinking Water Standards are also shown. As indicated, the standards for iron have been exceeded at three locations, RW-101, RW-204, and RW-205. A high concentration of manganese was also found in Well RW-101. None of these wells are reportedly used for drinking water supply at the present time, however.

Cyanide was found in the water sample taken from PW-305 in East Hanover Township. This well reportedly produces 500,000 gallons of water per day, for public consumption. Although the concentration of cyanide detected (23 ug/l) does not exceed the EPA interim standard of 50 ug/l, this detection should be acknowledged. It should be noted, however, that cyanide was also found in the field blank associated with monitoring well sampling

Table 3-11
Sharkey Landfill November 1985
Identified Inorganic Compounds
Potable Wells

Sample Location		RW-101	RW-203	RW-204	RW-205	RW-351	RW-365	PW-305
Sample Code		4886-R	4886-H	4886-D	4886-J	4886-Z	4886-S	4886-Y
INORGANICS	I.P.S**							
Aluminum		805 E	304 E	688 E	731 E	1160 E	1030 E	1240 E
Antimony			79					
Arsenic	50				14			
Barium	1000	18 []	5.9 []	32 []	49 []	5.2 []	32 []	11 []R
Beryllium			1.9 []			2.2 []		1.1 []
Cadmium	10	3.2 []E	8.2 E		5.9 E			
Calcium		30600	67300	58800	74000	27200	80100	57200
Chromium	50		11					46
Cobalt								
Copper	1000	18 []	16 []		42		7.2 []	7.6 []
Iron	300	3210	195	336	5990	88 []E	80 []	252 ER
Lead	50		13					
Cyanide	50							23
Magnesium		9710	12600	20300	19600	9670 E	23800	22600 E
Manganese	50	634	8.9 []	1910 E	1790 E	406 E	20 E	61 E
Mercury	2	0.1 []	0.1 []	0.1 []	0.1 []	0.1 []	0.1 []	0.1 []
Nickel								
Potassium		3690 []	1190 []	8130	5530	4870 []	5020	5000
Selenium	10							
Silver	50	3.2 []						
Sodium		10700	14500	31200	35900	10500 E	19100	14600 E
Thallium								
Tin		300 E						
Vanadium		74 E	37 []E	58 E	45 []E	102 E	95 E	97 E
Zinc		49 E	35 E	13 []E	39 E	16 []	54 E	33
Percent Solids		NA	NA	NA	NA	NA	NA	NA
Phenol								83.0
Pesticides	(none)							

Notes:

** -- EPA Interim Primary and Secondary Drinking Water Standards (1981-1982) in UG/L.
[] = If the result is a value greater than or equal to the instrument detection limit but less than the contract required detection limit, report the value in brackets.
. = Compounds underlined exceed I.P.S.**
... value estimated or not reported due to the presence of interference.
... sample recovery is not within control limits.
... ate analysis is not within control limits.
... in UG/L

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(Section 3.1.1). The validity of this detection is therefore questionable.

The chromium concentration in Well PW-305, at 46 ug/l, is near the interim standard of 50/ug/l. The chromium levels in this well, as a public water supply source, should be monitored regularly to assure that demonstrably safe levels are maintained. Chromium was also found in Well RW-203 at a concentration of 11 ug/l. This concentration is also below the intermim standard of 50 ug/l in this regard and does not warrant immediate concern, particularly since the well is reportedly not used as a drinking water source.

Only two tentative identifications of organic compounds in potable well samples are reported. These are summarized on Table 3-12.

Summary of Findings

3.1.4 Groundwater Contamination - Summary and Implications

A summary of standards for drinking water supplies, as compiled by the U. S. Environmental Protection Agency (EPA) and the New Jersey Department of Environmental Protection (NJDEP) for a variety of organic and inorganic compounds is provided on Table 3-15. Existing water quality criteria in terms of aquatic toxicity proposed or established by these agencies is also shown on this table.

3.1.4.1 Organic Compounds - To assess the degree of contamination in the groundwater beneath the landfill, the drinking water standards on Table 3-15 will be used. The concentrations of organic compounds identified at variou

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Table 3-12

Tentatively Identified Organic Compounds
Potable Well Investigations

Well Ref.	Compound	Fraction	Scan No.	Estimated Concentration
RW-101	Unknown	ABN*	191	10
RW-204	Unknown	VOA**	539	7

* Acid Extractible/Base Neutral (Semi-Volatile) Compound
** Volatile Organic Compound

TABLE 3-15

Summary of Drinking Water Standards and Aquatic Toxicity Criteria

	Drinking Water Standards			Aquatic Toxicity Criteria	
	Existing[a] Federal Standards	Proposed[b] Federal Standards	New Jersey Standards[e]	Proposed[d] EPA Criteria	New Jersey[c,e] Criteria
Organic Compounds					
Ethylbenzene	--	680	1,400[c]		32,000
Chlorobenzene	--	--	488[c]	--	250
Trichloroethylene	--	5	3.1	--	45,000
Carbon Tetrachloride	--	5	0.27	620	35,200
Vinyl Chloride	--	1	0.015	LD	--
1,2 Dichloroethane	--	5	0.7	3,900	20,000
Benzene	--	5	0.68	LD	5,300
1,1-Dichloroethylene	--	7	7.0	--	--
1,1,1-Trichloroethane	--	220	20.0	--	18,000
P-Dichlorobenzene	--	750	94.0	--	--
Tetrachloroethane	--	--	0.67	310	--
Chloroform	--	--	0.19[c]	500	28,900
Bromodichloromethane	--	--	--	140	--
Phenol	--	--	3,500[c]	600	2,560
Cyanide	--	--	200[c]	3.5[g]	3.5[g]
Total Trihalomethane	100	--	190[c]	--	11,000
Toluene	--	2,000	14,300[c]	--	17,500
Xylene	--	440	100	--	--
Napthalene	--	--	--	--	620
Inorganic Compounds					
Iron	300	--	--	--	--
Manganese	50	--	--	--	--
Antimony	--	--	146[c]	1,600	1,600
Arsenic	50	50[h]	.0022[f]	190[i]	440
Barium	1,000	1,500[h]	--	--	--
Beryllium	--	--	.0037[c]	5.3	5.3
Cadmium	10	5[h]	10[c]	0.66[i]	0.012
Chromium	50	120[h]	50[c]	120[i]	44
Copper	1,000	1,300[h]	--	6.5[i]	5.6
Lead	50	20[h]	50[c]	1.3[i]	0.75
Mercury	2	3[h]	.144[c]	0.012[i]	0.00057
Nickel	--	--	13.4[c]	56	56
Selenium	10	45[h]	50[c]	35	35
Silver	50	--	--	0.009	0.012
Thallium	--	--	--	--	40
Zinc	--	--	--	47	47

[a]EPA National Interim Primary Drinking Water Standards, 47 FR 10998, March 12, 1982 and Secondary Drinking Water Standards, July 1981.

[b]Proposed Maximum Contaminant Levels (MCLs) and Recommended Maximum Contaminant Levels (RMCLs) In Drinking Water Federal Register 40 CFR Parts 141 and 142, November 13, 1985.

[c]New Jersey Pollutant Discharge Elimination System (NJPDES) Regulations Toxic Effluent Limitation, October 1984.

[d] Proposed Criteria for Toxic Substances Designated to Protect Aquatic Life, EPA-600/6-82-049, June 1982.

[e]New Jersey Interim Action Levels for Drinking Water, January, 1986; (Maximum Level I concentration indicated - No recommended action, random spot check sampling)

[f]For the less common trivalent form of arsenic.

[g]For free cyanide.

[h]Proposed RMCLs (nonenforceable goals)

[i]EPA Ambient water qualilty criteria (50 FR July, 19, 1985); Based on: for; Arsenic III, Mercury: limit of no unnacceptable effects over a 4-day average concentration, once every three years on the average (fresh water). For; Cadmium, chromium (III), copper, lead: limit of no unacceptable effects over a 4-day average concentrations, once every three years on the average (fresh water; at a hardness of 50 mg/l($CaCo_3$).

LD = Less Than Detection Limit.

Note: All units ug/l.

locations in the groundwater sampling program have been compared to these standards. Where an established standard or guideline exists and has been exceeded, the sampling location and compound are listed on Table 3-16. In the compilation of this information, the compounds identified on Tables 3-3 and 3-7 in Section 3.1 have been used, eliminating from consideration compounds reported in field and trip blanks.

On the basis of this analysis, it is apparent that there are no semi-volatile compounds detected at levels exceeding the drinking water standards used in this assessment. Only two volatile organic compounds exceed the standards: benzene and trichloroethylene (TCE). As shown on Table 3-16, trichloroethylene exceeded the drinking water standards only at Shallow Well WS-6. Benzene was found in two of the four shallow wells on the North Fill, Wells WS-12 and WS-13 and at the northern and western edges of the South Fill in Shallow Wells WS-17 and WS-6, respectively.

As noted in Section 3.1.2.2, chloroform was reported in Well WS-13 at a concentration of 34 ug/l (Table 3-2). Since it was identified in a trip bland (Table 3-1), it was not included on Table 3-3, and thereby did not qualify for inclusion on Table 3-16. However, its possible presence in the well should be recognized. As shown on Table 3-15, the NJPDES standards for chloroform are 0.19 ug/l.

The only intermediate well that exceeded these standards was WI-17 with 13 ug/l of benzene reported.

No semi-volatile organic compounds in excess of the standards provided on Table 3-15 occurred in the groundwater sampling program. Furthermore, with the exception of benzene and TCE, no

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TABLE 3-16

SHARKEY LANDFILL
Identified Organic Compounds Exceeding Applicable Criteria

Volatile Compounds	Drinking Water Standards: EPA Proposed MCL or RMCL	Drinking Water Standards: NJ Interim Action Level	Monitoring Wells Exceeding Criteria: WS-5	WS-6	WS-12	WS-13	WS-17	WI-17
Benzene (ug/l)	5	0 - 0.68* >0.68 $\leq$ 6.8** >6.8 $\leq$ 68***	28	6	5	22	4	13
Trichloroethylene (ug/l)	5	0 - 3.1* >3.1 $\leq$ 30** >30 $\leq$ 309***		13				

NOTE: NJDEP INTERIM ACTION LEVEL - <u>SUMMARY OF RESPONSES</u>

* Level I - No recommended action, random spot check sampling.

** Level II - Confirm sampling results; periodic monitoring; recommend alternative water sources and/or appropriate treatment techniques.

*** Level III - Confirm sampling results; monthly monitoring; develop within one year alternative water supplies and/or appropriate treatment techniques for public community water systems; recommend appropriate remedial actions from both public community and public noncommunity water systems.

Level IV - Confirm sampling results; immediate remedial action for both public community and public noncommunity water systems.

other identified compounds exceeded either the drinking water standards or aquatic toxicity criteria for organic compounds.

3.1.4.2 Inorganic Contaminants - Using the standards and criteria provided on Table 3-15, a summary of inorganic contaminants exceeding the drinking water standards is provided on Tables 3-17 and 3-18 for the shallow and lower aquifer, respectively.

Beryllium levels exceeded the NJPDES standards in seven shallow wells and three lower aquifer wells. It should be noted, however, that the levels observed are all below 10 ug/l with the exception of Well WI-10, which penetrates the lower aquifer.

In summary, most significant, in terms of inorganic contamination on site, were the detections of cadmium, chromium, cyanide, lead and nickel. High levels of iron and manganese appear to be common throughout the area. Therefore, assessing landfill contributions of these parameters would be very speculative.

The cyanide detection remains indeterminate due to questionable laboratory data. However, the low level detection of cyanide in Well PW-305, the East Hanover Township Homestead Avenue well, should be reassessed. The presence of cadmium, chromium, lead and nickel were generally above drinking water standards in the landfill, and are probably largely derived from landfill deposits. There does not appear to be an adverse effect on the Rockaway or Whippany Rivers downstream on the basis of wet weather sampling results, however. In addition, cadmium levels above drinking water standards were also detected upstream of the fill area in the Rockaway River.

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TABLE 3-17

SHARKEY LANDFILL
Summary of Identified Inorganic Contaminants Exceeding Drinking Water Standards - Shallow Wells

Inorganic Contaminants	Drinking Water Standards: EPA Interim Standards	EPA Proposed MCL & RMCL	NJ (NJPDES)	Monitoring Wells Exceeding Standards: WS-1	WS-2	WS-3	WS-4	WS-6	WS-7	WS-8	WS-9	WS-11	WS-12	WS-13	WS-14	WS-17	MW-203	MW-351
Beryllium			.0037	1.8		2.7	2.4	3.1			2.8	1.7		2.9			1.9	2.2
Cadmium	10	5	10		11	8.4		13			7.4	5.3		4.1		8.1		
Chromium	50	120	50	77		54	341	4990		48	146	334	75	182	89			
Iron	300						Exceeds Standards At All Sampling Locations - Laboratory Interference Noted											
Lead	50	20	50			290	81	63	29		480		77			145*		
Cyanide	50		200			248												
Manganese	50						Exceeds Standards At All Sampling Locations - Laboratory Interference Noted											
Mercury	2	3	0.144			1	1				1.6							
Nickel			13.4	52		172	246	87	63	60	564	1390	320	405	60	41		

* Sample interference noted
. All values reported in ug/l

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TABLE 3-18

SHARKEY LANDFILL
Summary of Identified Inorganic Contaminants Exceeding Drinking Water Standards - Lower Aquifer

Inorganic Contaminants	Drinking Water Standards: EPA Interim Standards	EPA Proposed MCL & RMCL	NJ (NJPDES)	Monitoring Wells Exceeding Standards: WD-2	WD-3	WI-3	WI-4	WI-6	WI-7	WI-8	WI-10	WI-15	WI-16	WI-17	RW-101	PW-305
Beryllium			.0037		7			3			13					1.1
Cadmium	10	5	10	25									19*			
Chromium	50	120	50		143	68		97			492			206		
Iron	300			Exceeds Standards At All Sampling Locations - Laboratory Interference Noted												
Lead	50	20	50		80											
Manganese	50			441*	14,700*	195*	225*	916*	150*	164*	19,900	367*		429*	634	
Mercury	2	3	0.144													
Nickel			13.4	39	307	72	17	49	16	31	594			181		

* Sample interference noted
. All values reported in ug/l

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Phenol levels are all below the NJPDES drinking water standards of 3500 ug/l. However, it was detected at many locations throughout the area, including the potable water supply wells sampled. In view of fluctuating criteria for this contaminant, resampling of potential drinking water sources in the area would be advisable to confirm the presence of the contaminant.

3.1.4.3 Shallow Aquifer - Implications - The nearest known downstream public use of the shallow aquifer is at Little Falls, where the Passaic Valley Water Commission has an intake at the Passaic River at that location. This plant serves approximately 259,000 people in the area and withdraws approximately 35,000,000 gallons per day (gpd). Additional wholesaling of this water supply to other areas in the region can reach a population of up to 600,000 people, according to the water commission. Further information obtained from the water commission indicates that within approximately one to two years the intake will be shifted to the Prompton River, deriving most, if not all of, the required water supply from that drainage basin.

The present intake for this water supply is greater than approximately eight miles downstream of the Rockaway/Passaic confluence.

The total identifiable volatile organics from Table 3-3 for each well in the shallow aquifer have been projected on Figure 2.4-5 (Section 2.4) which also shows the shallow groundwater level contours. It is apparent that there are potentials for contaminant transport from ~~the~~ North Fill to the Rockaway River, probably the most concentrated levels throughout the study area. However, drinking water standards for identified organic compounds were exceeded in only two of these wells, WS-12 and WS-13, for the compound benzene, at very low levels of

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concentration, less than 25 ug/l. Furthermore, surface water sampling conducted during the wet weather survey did not detect organic contamination in the Rockaway River either upstream or downstream from the North Fill.

On the basis of Monitoring Sites WS-2, WS-3 and WS-17, at the perimeter of the South Fill area, very low levels of total identifiable organic contamination are present and discharged to the river. The highest contaminant levels on the South Fill were observed at Well WI-6, which is probably contributing groundwater to either well site WS-3 or WS-2. In terms of drinking water standards, these latter two wells are below the standards for volatile organic compounds. WS-6, however, exceeds the standard for benzene, with a concentration of 6 ug/l for that compound.

In comparison to the South Fill, the Northwest Fill is contributing relatively higher levels of organic contamination. The only well sampled in that area, WS-5, is also the only well where the standards for both benzene and TCE have been exceeded. Neither of these compounds have been found in either the Whippany River surface water samples or leachate samples of the Northwest Fill area.

The Southwest Fill appears to be contributing extremely low levels of organic contamination. However, on the basis of surface water and leachate sampling, there does not appear to be an adverse affect on the Whippany River quality from the landfill.

In summary, although organic contamination has been detected in each fill area, levels of contamination do not appear to be resulting in adverse effects of the quality of the adjacent Rockaway and Whippany Rivers. Furthermore, there are no known drinking water sources or private wells within the area immediately downgradient from the landfill. Therefore, the contamination noted does not appear to pose an immediate off-site threat.

3.1.4.4 Lower Aquifer - Implications - Organic contamination was only found in one well in the lower aquifer, Well WI-17. The concentration of benzene (13 ug/l) in this well does not meet drinking water standards. However, this detection is an isolated occurrence and does not necessarily imply significant contamination of the lower aquifer. Insofar as no other detections of this nature were made in the lower aquifer on site, assessment of this detection, in terms of environmental impact, should be withheld. The well should be resampled to certify the presence of benzene at this location. If this presence is confirmed, additional hydrogeologic investigation in the vicinity should be performed to fully delineate the extent of contamination.

The lower aquifer is used as a source of drinking water supply in the area. The East Hanover Township water supply system reportedly operates two wells in the township and plans to put another in service within a year. The system serves a population of approximately 9,000. There are also a variety of domestic wells, presumably constructed in the lower aquifer throughout the community surrounding the landfill. On the basis of sampling data, however, there is no evidence that the landfill is adversely affecting drinking water quality in the area.

The cyanide and phenol levels in the public water supply wells should however, be monitored and evaluated.

3.2 Soil Sampling

Five locations were selected within the landfill study area to obtain shallow soil samples for chemical analysis. The sampling locations, shown on Plate 3-1, were placed in leachate seep drainageways (Sampling Site S-1 and S-5), storm water drainageways (Site S-3 and S-4), and areas of unexplained anomalous electromagnetic readings (Site S6), as discussed in Section 3.3. The method of soil sampling was performed in accordance with the FSP. However, the FSP indicated only four sites to be sampled. The fifth site (S6) was selected following evaluation of the electromagnetic survey data (Section 3.3).

3.2.1 Results

Five soil samples were collected. Geologic descriptions of the soils and materials removed during this sampling are provided in Appendix B-9. The samples were collected on November 6 and 7, 1985, and submitted to the U. S. Testing Company laboratory for analysis on November 7 and 8, 1985.

Table 3-13 shows a summary of volatile and semi-volatile organic compounds and pesticides detected in the soil samples and field blanks prepared as part of the soil sampling effort. Table 3-14 shows the results of analyses for inorganic compounds. Five volatile organic compounds were identified. These include methylene chloride, acetone, tetrachloroethene, 2-butanone and carbon disulfide. Of these, methylene chloride and tetrachloroethene (PCE) were also found in the soil sampling field blanks. Carbon disulfide was reported in two trip blanks (Table 3-1, Section 3.1). It is important to note that the field blank samples were submitted as water samples, collected by decanting laboratory provided deionized water into or throug

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TABLE 3-13

SHARKEY LANDFILL
Summary of Identifiable Organic and Pesticide Compounds - Soil Sampling Program

Sample Location	S1	S3	S4	S5	S6	Field Blank/Soils	Field Blank/Soils	Field Blank/Soils
Sample Code	4887-A-S1	4887-B-S3	4887-C-S4	4887-D	4887-E	4886-AA	4886-M	4886-V
Volatile Organic Compounds								
methylene chloride				8	8	2 JB	4 J	
acetone		57		16				
tetrachloroethene				2 J		3 J		3 J
2-butanone		20						
Carbon Disulfide				10	20			
Semivolatile Organic Compounds								
bis(2-Ethylhexyl)Phthalate	210 JB		520 B	20000 B		4 JB		12 J
naphthalene			400	760 J				
Phenanthrene			200					
Benzo(a)Pyrene		1500			180 JB			6 JB
2-Methylnapthalene			5000					
Fluoranthene			240 J					
Pyrene			80 J					
Pesticide								
Dieldrin				330				
4,4'-DDD				370				
Aroclor-1254		130	380					
Endrin Ketone				410				
Methoxychlor								0.41

B - The analyte was found in the blank as well as the sample. It indicates possible/probable contamination and warns the data user to take appropriate action.

J - Indicates an estimated value. This flag is used either when estimating a concentration for tentatively identified compounds where a 1 : 1 response is assumed or when the mass spectral data indicated the presence of a compound that meets identification criteria but the result less than the specified detection limit but greater than zero (e.g. if limit of detection is 10 ug/l and a concentration of 3 ug/l is calculated report as 3J).

o - All results in micrograms per kilogram (ug/kg) except for field blanks which are reported in microgram per liter (ug/l).

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TABLE 3-14

SHARKEY LANDFILL
Summary of Inorganic Compounds - Soil Sampling Program

Sample Location Sample Code	S1 4887-A-S1	S3 4887-B-S3	S4 4887-C-54	S5 4887-D	S6 4887-E	Field Blank/Soils 4886-AA	Field Blank/Soils 4886-M	Field Blank/Soils 4886-V
Inorganics								
Aluminum	36100	7910	7640 E	9390	6100	333 E	1040 E	1130 E
Antimony	32 R							53 []
Aresenic	5.7 R							
Barium	191	80 []E	60 []E	64 []	37 []	2.8 []		8.6 []
Beryllium	1.8 []	0.6 []						
Cadmium	4.6		1.6 []	2 []	2 []		2.6 []	2.8 []
Calcium	14	1620 []E	182 []E			153 []	361 []	377 []
Chromium	69	18	46	19	23			
Cobalt	17 []	13 []	5.4 []	9 []	3.8 []			4.4 []
Copper	30	48 E	73	61	18 []	12 []		
Iron	66300	19700	18600	21800 E	11700 E	64 []	203 E	54 []E
Lead	52 ER	159 E	138 E	776		8.7		
Cyanide	1.9							
Magnesium	2850 []	5150 E	3990 E	3330 E	2330 []E	202 []	675 []E	769 []E
Manganese	1980	319	323	316 E	168 E		7.1 []E	7.1 []E
Mercury	0.1 []	0.3	0.1 []	0.6	0.1 []	0.1 []	0.1 []	0.1 []
Nickel	39	27	40	49				
Potassium	797 []E	2920	2340 []	4270	357 []	929 []E	3720 []	4190 []
Selenium	36 R							
Silver	2.2 R							
Sodium	343 []E	671 []E	821 []E	1410 []E	475 []E	494 []	1260 []E	1370 []E
Thallium	5.0 R							
Tin	8.2 R	121				130		
Vanadium	157 R	60 E	54 E	113 E	6.8 []	26 []	87 E	100 E
Zinc	108	117 E	214 E	192	49	29	34	26
Percent Solids	67	87	80	83	68	NA	NA	NA

Notes:

[] - If the result is a value greater than or equal to the instrument detection limit but less than the contract required detection limit, report the value in brackets. Indicate the analytical method used with P (for ICP/Flame AA) or F (for furnace).
R - Indicates spike sample recovery is not within control limits.
* - Indicates duplicate analysis is not within control limits.
o - All results are in ug/kg, except field blanks, reported in ug/l.
E - Indicates a value estimated or not reported due to the presence of interference.

soil sample collection devices into laboratory provided sample bottles. Results for field blanks are therefore reported in terms of ug/l, not ug/kg.

In addition to the low levels of volatile and semi-volatile organic compounds found in the field blanks from the soil sampling, one pesticide, methoxychlor, at 0.41 ug/l and a variety of inorganic compounds were also detected. The latter compound however, was not identified in any of the soil samples.

The compounds detected in field or trip blanks are questionable and should not be considered as site derived unless further qualification or proof of sample report validity is provided. Therefore, of the organic compounds reported, acetone, 2-butanone, naphthalene, phenanthrene, 2-methylnaphthalene, fluoranthene and (possibly) pyrene are associable with the samples.

Acetone and 2-butanone were found at Site S3, near Monitoring Well WD-3. Acetone was also reported in the sample from Site S5. In the semi-volatile fraction, pyrene (80 ug/kg), fluoranthene (240 ug/kg) and 2-methylnapthalene (5,000 ug/kg) were found at Site S4.

Four pesticides were identified in soil samples. Three of the four compounds were found at Site S5. These include dieldrin, 4,4'-DDD and endrin ketone at concentrations ranging between 330 and 410 ug/kg. The PCB Aroclor-1254 was found at Sites S3 and S4 at 130 and 380 ug/kg respectively.

An array of inorganic chemical species (Table 3-9) was detected in the soil samples from the five sites. In general, these detections are not unexpected, considering the inorganic matrix that the soils are composed of, nor are there indications of major anomalies between the sample sites and respective compounds.

There are no demonstrably reliable criteria available to evaluate the concentrations of the contaminants that were found in the soils. The levels of organic compounds found in the soils appear to be relatively low, and at least half of the compounds reported have been found in the field and trip blank analyses. The remaining compounds are in relatively low levels and do not suggest that problem contaminant source areas are present at the near surface at the sampling locations. It is noteworthy perhaps, that acetone and naphthalene were also found in the groundwater. There is no apparent direct correlation between the locations of respective soil/groundwater sampling sites and the compounds that were identified; for example, acetone occurred at S3 and S5 and Monitoring Well WS-2; naphthalene and methylnapthalene occurred at S3 and S4 and WS-4, 5, 6, and all monitoring well locations on the North Fill. Although pesticides were identified in three soil samples, none were found in groundwater samples.

3.3 Electromagnetic Survey

An electromagnetic (EM) survey was conducted to determine, if possible, the extent and relative degree of shallow groundwater contamination, and to aid in the location of shallow concentrated leachate. The EM survey was conducted around the perimeter of the major landfill areas at the site. In areas where anomalously high or low relative EM readings were observed, a magnetometer survey was subsequently performed to determine if the readings were caused by buried metallic wastes.

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3.3.1 Survey Methods

3.3.1.1 Electromagnetic Survey Methods - A Geonics EM-31 electromagnetic induction meter (EM-31) was used to complete the electromagnetic survey. The EM-31 meter is particularly well suited for the location of shallow conductive leachate, saline solutions, acids, and metals. However, it cannot necessarily distinguish which of these materials is the source of a high or low conductivity reading. This instrument measures the apparent conductivity of the earth to a depth of about 20 feet, accentuates shallow features and is affected by metallic masses at, near, or above the surface of the ground. In particularly conductive areas, resultant readings are generally nonlinear, and low or even negative values are possible. The unit of conductivity measurement is millisiemens per meter (mS/m), which is equivalent to millimhos per meter.

The EM survey was completed between November 26-28, 1984. A total of 991 measurements were made at 25 foot spacings along the traverses. The traverses were made around the perimeter of each fill area in a counterclockwise direction. Relative position along each line was determined using a 300-foot long rope with painted bands at 5-foot intervals. Topography, vegetation and stretching affect the accuracy of the measurement positions determined with the rope. Therefore, blue flags were placed and labeled at 100-foot intervals on each traverse for the purpose of point relocation, if necessary. Compass direction and other field notes were taken to assist in locating the survey lines on the map and relocating survey positions in the field.

The EM-31 meter was carried at waist height, with dipoles vertical. The bar of the instrument was oriented along the line of traverse. For much of the traverse length, it was necessary to cross obvious or possible fill. These areas were documented in the field. During the period of survey, the weather was warm and rain free.

3.3.1.2 Magnetometer Survey Methods - The magnetometer surveys were conducted using a Scintrex MP-2 Proton Magnetometer. In the combined surveys, a total of 387 field measurements were made at 10-foot intervals along parallel lines established in each survey area. These lines were approximately 10 feet apart. No temporal corrections were made to the magnetic data presented herein. Variations in earth's magnetic field, shown on Figure 3.3-1, were not large over the time interval of any individual survey to warrant a magnetic correction of the associated data.

3.3.2 Survey Results

The electromagnetic (EM) conductivity traverse lines are shown on Figure 3.3-2. Where the traverse lines pass from natural deposits to obvious fill material, the sharp contrasts in conductivity readings indicate the presence of buried metallic debris in the soil near the line of traverse. The anomalous conductivity measurements observed on obvious fill material must be discounted or at least considered inconclusive, due to the effect of buried debris.

Contrasts between soil and conductive chemicals, however, have smooth, less "noisy" profiles. There were five locations where the possible presence of leachate or conductive chemicals was suggested by the survey. These are shown on the figures.

3.3.2.1 North Fill Perimeter - Three areas, labeled A1, A2, and A3, appear on Figure 3.3-3 as electromagnetic anomalies, or potential subsurface areas of contamination occurring around the

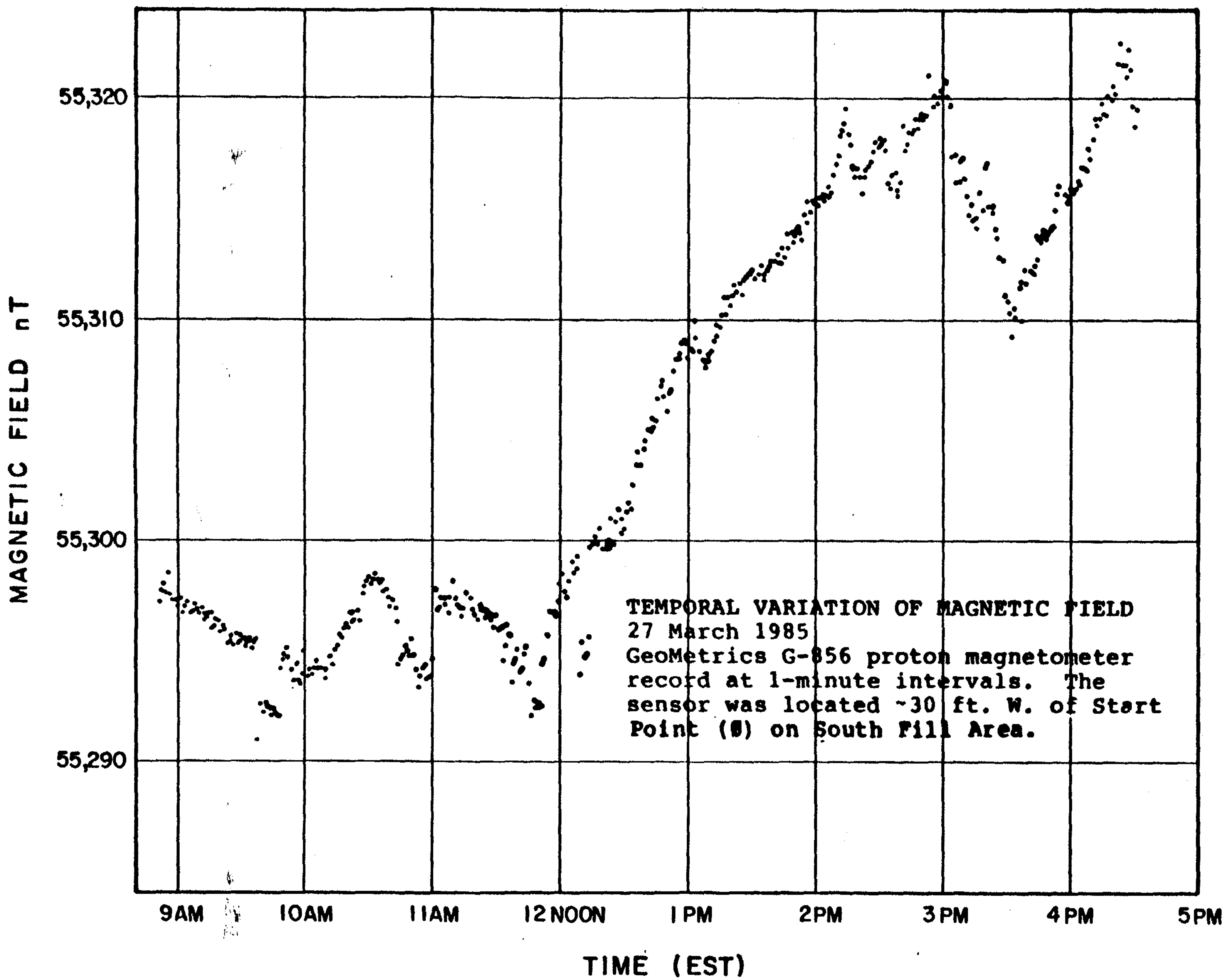
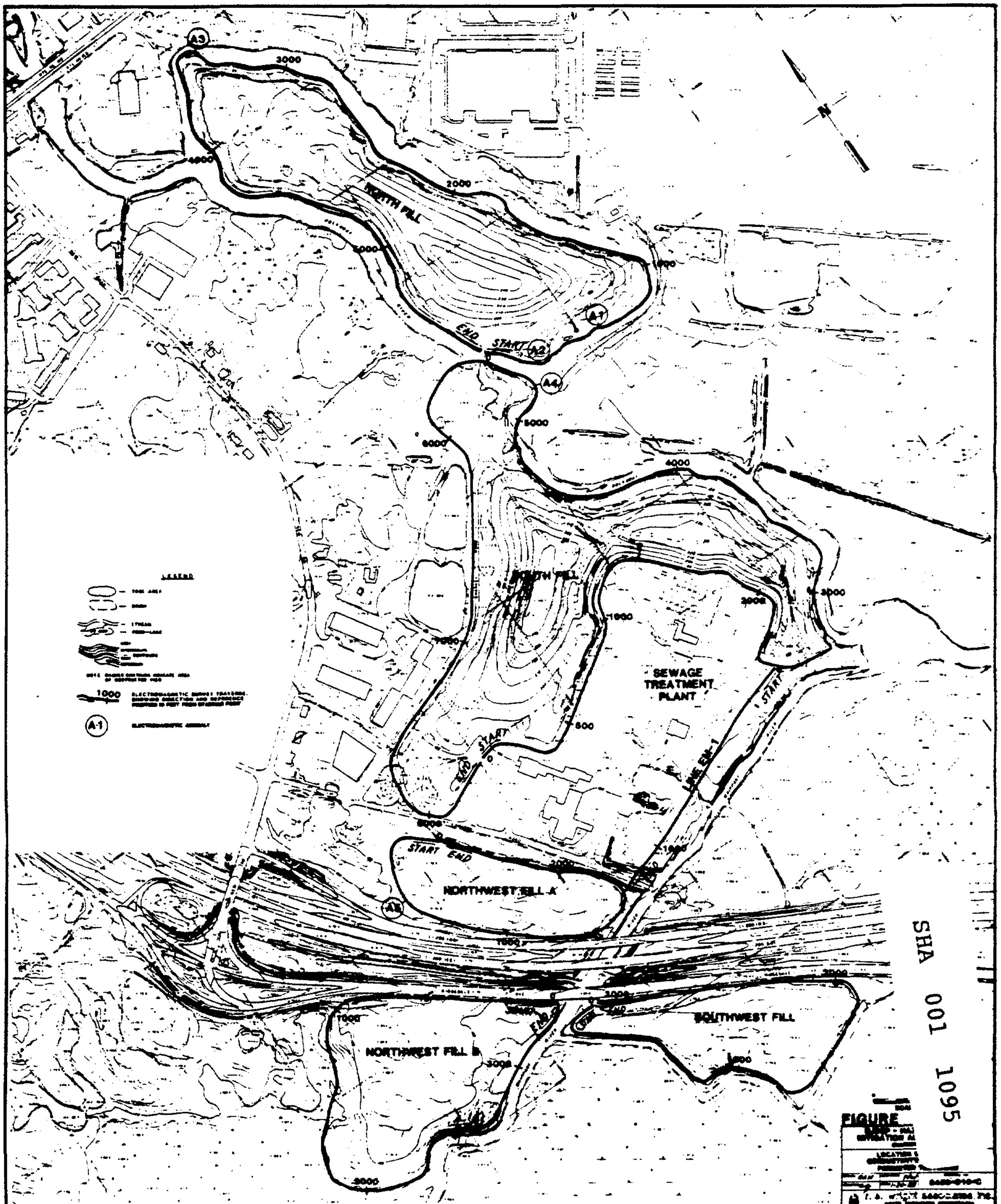

MAGNETIC FIELD nT
55,320
55,310
55,300
55,290
9AM
10AM
11AM
12 NOON
1 PM
2PM
3 PM
4 PM
5 PM
TIME (EST)
TEMPORAL VARIATION OF MAGNETIC FIELD
27 March 1985
GeoMetrics G-856 proton magnetometer record at 1-minute intervals. The sensor was located ~30 ft. W. of Start Point (0) on South Fill Area.

Figure 3.3-1


NORTH FILL
SOUTH FILL
SEWAGE TREATMENT PLANT
NORTHWEST FILL A
NORTHWEST FILL B
SOUTHWEST FILL
LEGEND
ELECTROMAGNETIC ANOMALY
START
END
A-1
A2
A3
A4
3000
2000
1000
4000
5000
6000
500
FIGURE

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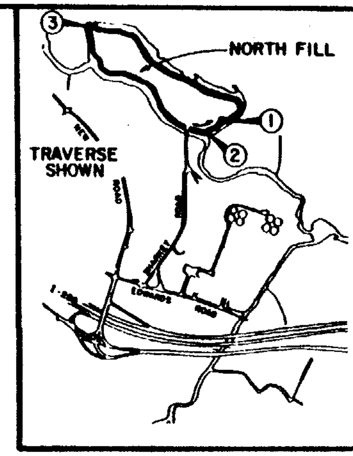

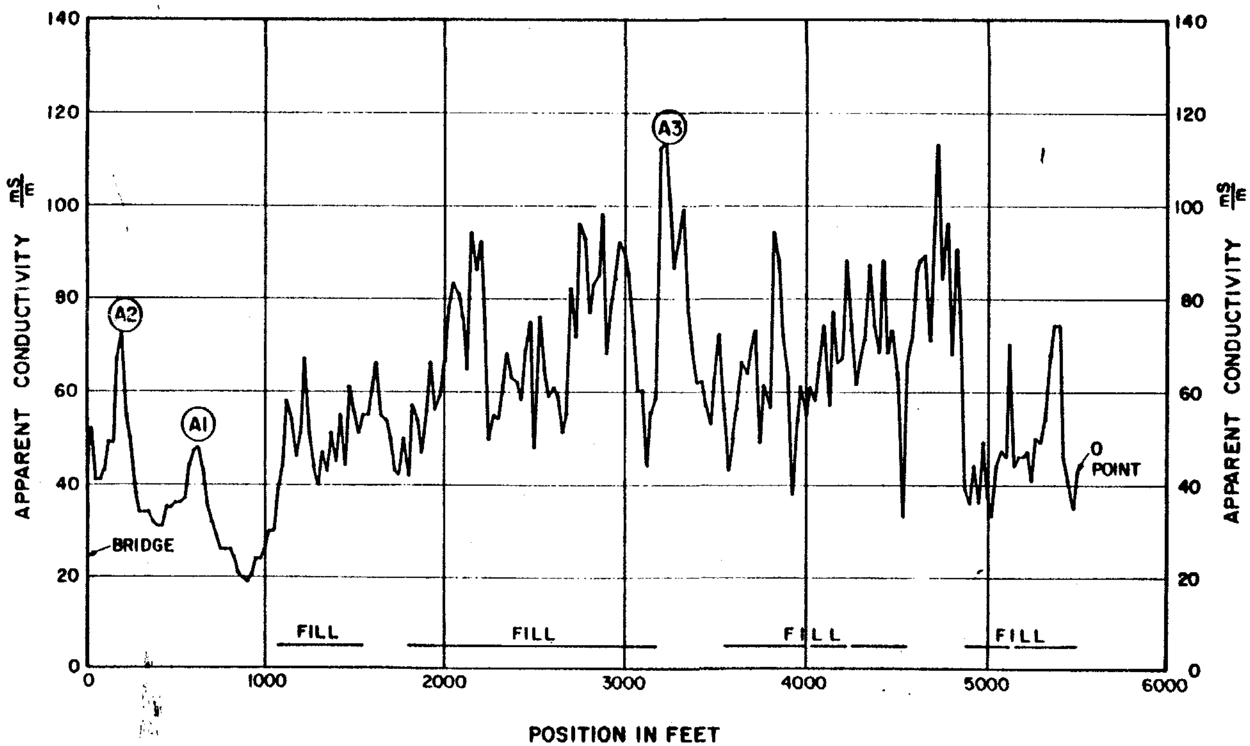

(A2) ELECTROMAGNETIC ANOMALY

SHARKEY LANDFILL

ELECTOMAGNETIC CONDUCTIVITY - NORTH FILL PERIMETER

drawn RAM | date 7-17-85 | FIGURE 3.8-3

f. e. wright associates, inc. earth resources consultants

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North Fill perimeter. In each case, fill material was not observed at the ground surface, and the readings appeared indicative of abnormally conductive soil. These EM anomaly areas were subsequently surveyed with the magnetometer.

3.3.2.1.1 Anomaly A1 - The magnetic survey at EM Anomaly Site A1 was conducted at least 25 feet to the south of the primary landfill mound at that location. However, a small amount of fill material was visible at the surface. The contour map of magnetic data obtained during the survey, shown on Figure 3.3-4 indicates very little buried iron is present in the area. The steep magnetic gradient between traverse positions 500 and 575 suggests that an iron mass is present within an undetermined distance from the edge of the survey. However, no iron mass is indicated within the immediate survey area. The anomaly at Position 650 suggests that an iron mass is buried at a considerable depth near that location. The shape and size of the anomaly indicates that the source is much too deep to have produced the anomalous EM-31 reactions indicated on Figure 3.3-3.

This area was resurveyed with the EM-31 to verify the existence of the electromagnetic anomaly. As shown on Figure 3.3-5, the electromagnetic conductivity was greatest at a broad, shallow topographic depression forming a small pool of water in the muddy stream bed. A plume of high conductivity radiates from this area. Several factors, including the visibly wet conditions, soft mud and fine-grained sediments could contribute to the anomalous readings. However, the high conductivity zone extends to the east at least 100 feet from the pool. Conductive leachate could be the primary source of the high readings, even though the water in the pool was not noticeably discolored or visibly contaminated.

ANOMALY A1

MAGNETIC MAP

Contour Intervals: 25nT

Survey Date: 27 March 1985

Survey Time: 12:49 to 1:10 P.M.

Instrumentation:
- Scintrex MP-2 Magnetometer
- Sensor Height 5 ft.
- Recorded WXYZ in 5W, XYZ nT Total Flux density
- No Temporal Correction

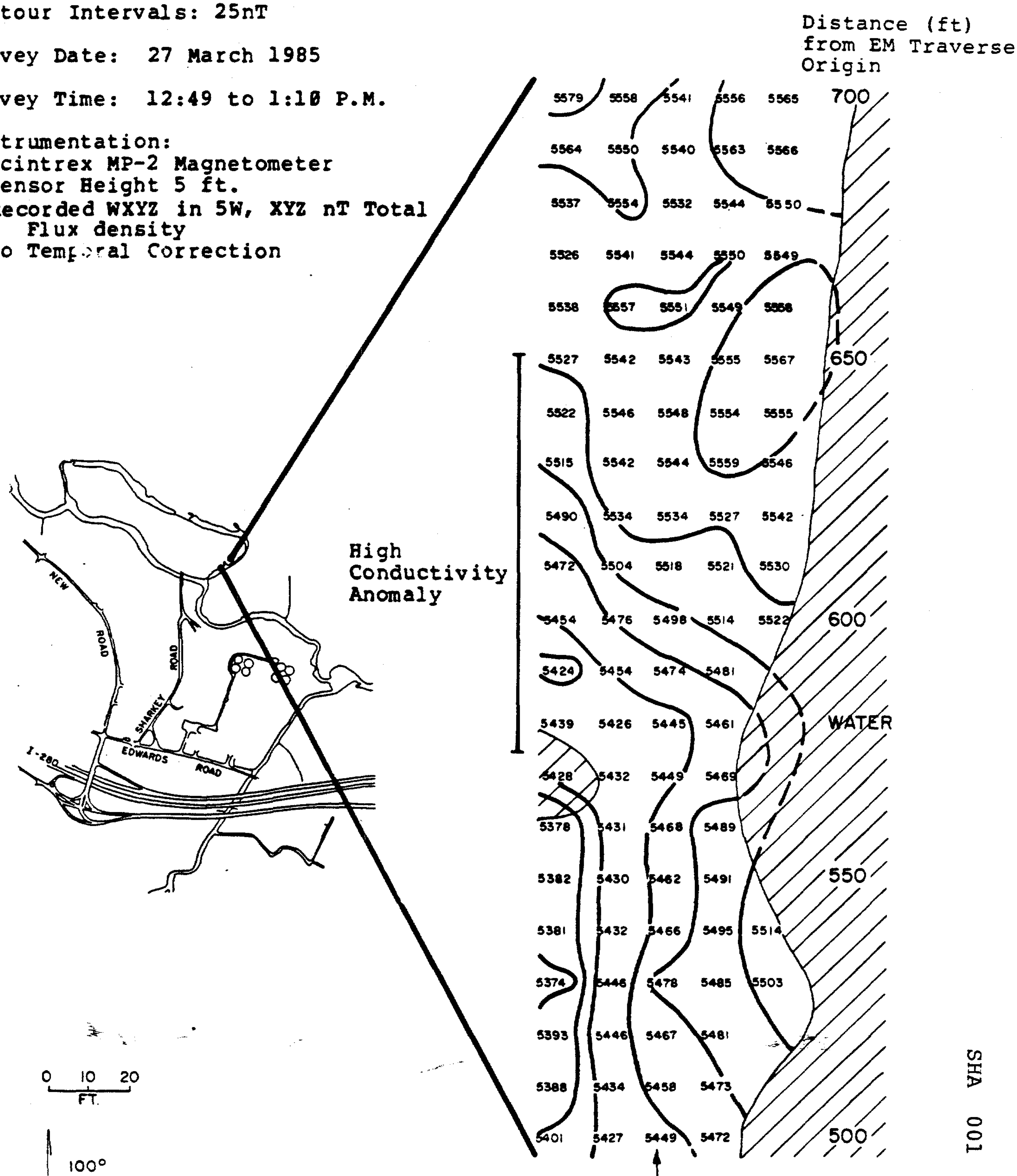

Figure 3.3-4: Magnetic Contour Map, EM Anomaly Area A1.

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ANOMALY A1

EM CONDUCTIVITY MAP - RESURVEY

Contour Interval: 2 $\frac{mS}{m}$

Survey Date: 27 March 1985

Survey Time: 3:28 to 3:50 P.M.
Instrumentation:
Geonics EM-31
DiPoles Vertical
Bar Height 3 ft.
Bar Direction E-W

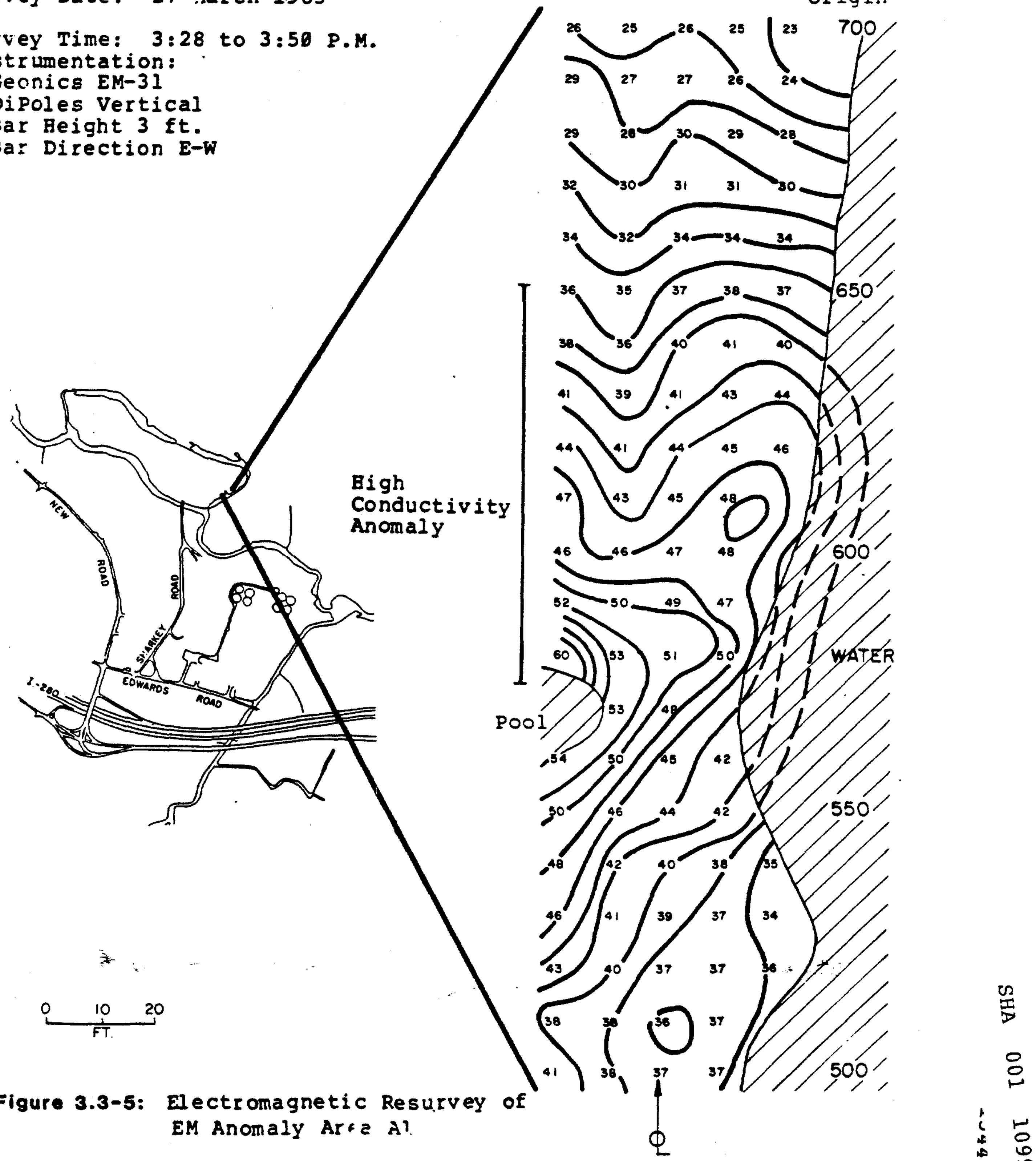


Figure 3.3-5: Electromagnetic Resurvey of EM Anomaly Area A1

The results of the magnetometry survey at EM Anomaly A1 suggested that the EM readings could be a result of subsurface leachate migration. Therefore, further investigation was conducted. A hand-augered soil sample (S6) composited from the depth interval of 0 to 7 feet was collected at this site for chemical analysis. The results of this analysis is discussed in Section 3.2.

3.3.2.1.2 Anomaly A2 - Two distinct magnetic features were indicated as a result of the magnetometer survey of EM Anomaly A2 area (Figure 3.3-6). In the vicinity of the EM anomaly, the magnetic field is disturbed by an empty metal drum at the surface. Clearly, the drum is the sole cause of the EM anomaly.

The lower portion of the figure, near the abandoned bridge crossing to the South Fill area and Survey Position 100 shows a second magnetic signature derived from the toe of the landfill slope. The steep magnetic contours suggest the presence of metallic materials buried near the edge of the fill.

3.3.2.1.3 Anomaly A3 - Due to physical access restrictions created by the stream channel, some areas adjacent to EM Anomaly Area A3 could not be measured with paralleling magnetic measurements. However, a single magnetic traverse was conducted over the EM line (Figure 3.3-7). Where several parallel magnetic measurement lines were possible, the data shows the expected high magnetic signature of the landfill edge. At this location, the EM anomaly can be unquestionably attributed to the physical proximity of the landfill.

3.3.2.2 South Fill Perimeter - Figure 3.3-8 shows the electromagnetic readings observed during the traverse around the South Fill area. The most significant EM anomaly, in terms of

ANOMALY 2

MAGNETIC MAP

Contour Intervals: 100nT

Survey Date: 27 March 1985

Survey Time: 12:18 to 12:32 P.M.

Instrumentation:
Scintrex MP-2 Magnetometer
Sensor Height 5 ft.
Recorded WXYZ in 5W, XYZ nT Total Flux density
No Temporal Correction

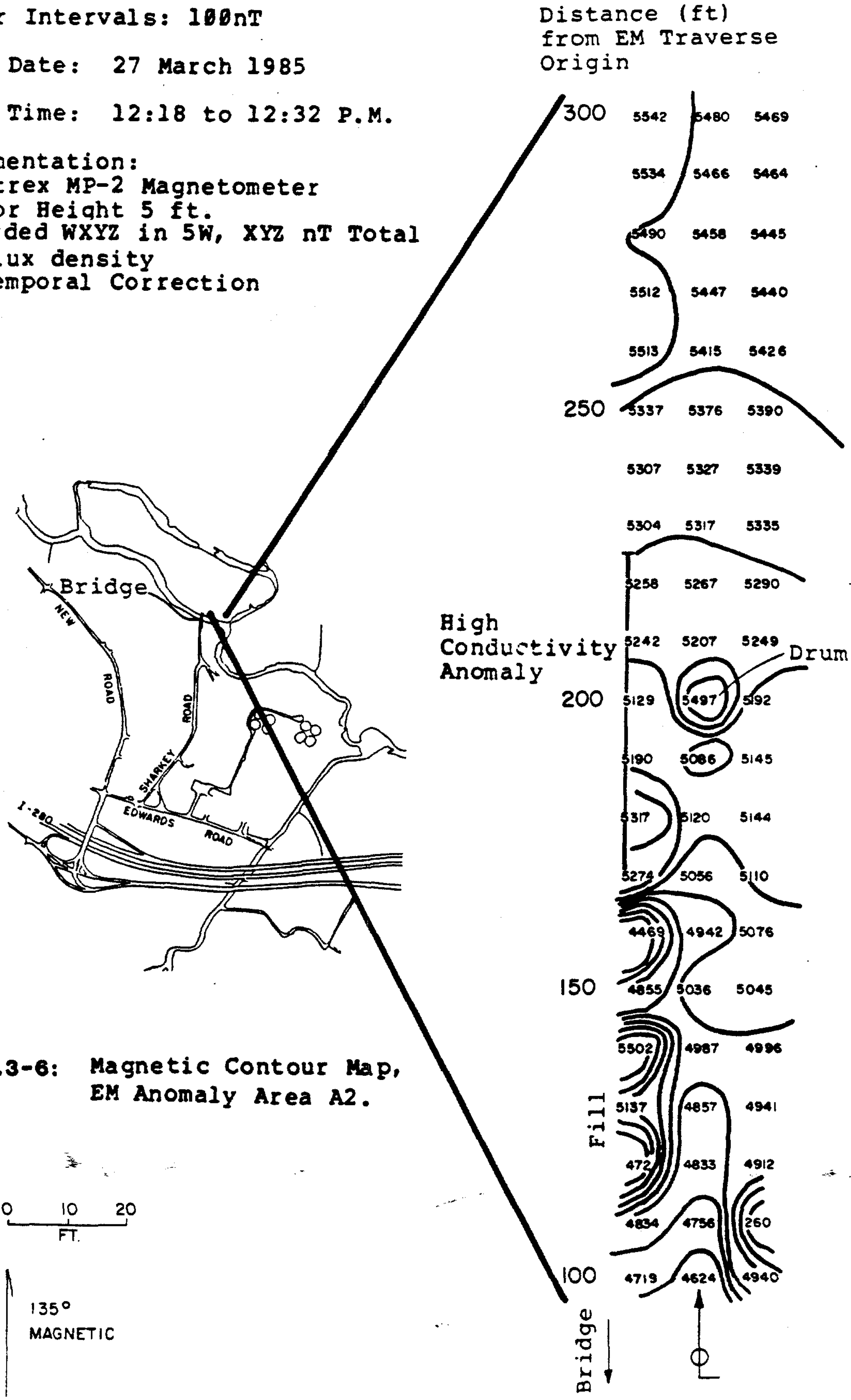


Figure 3.3-6: **Magnetic Contour Map, EM Anomaly Area A2.**

ANOMALY 3

MAGNETIC MAP

Contour Intervals: 200nT

Survey Date: 27 March 1985

Survey Time: 2:06 to 2:20 P.M.
Instrumentation:
  Scintrex MP-2 Magnetometer
  Sensor Height 5 ft.
  Recorded WXYZ in 5W, XYZ nT Total
    Flux density
  No Temporal Correction

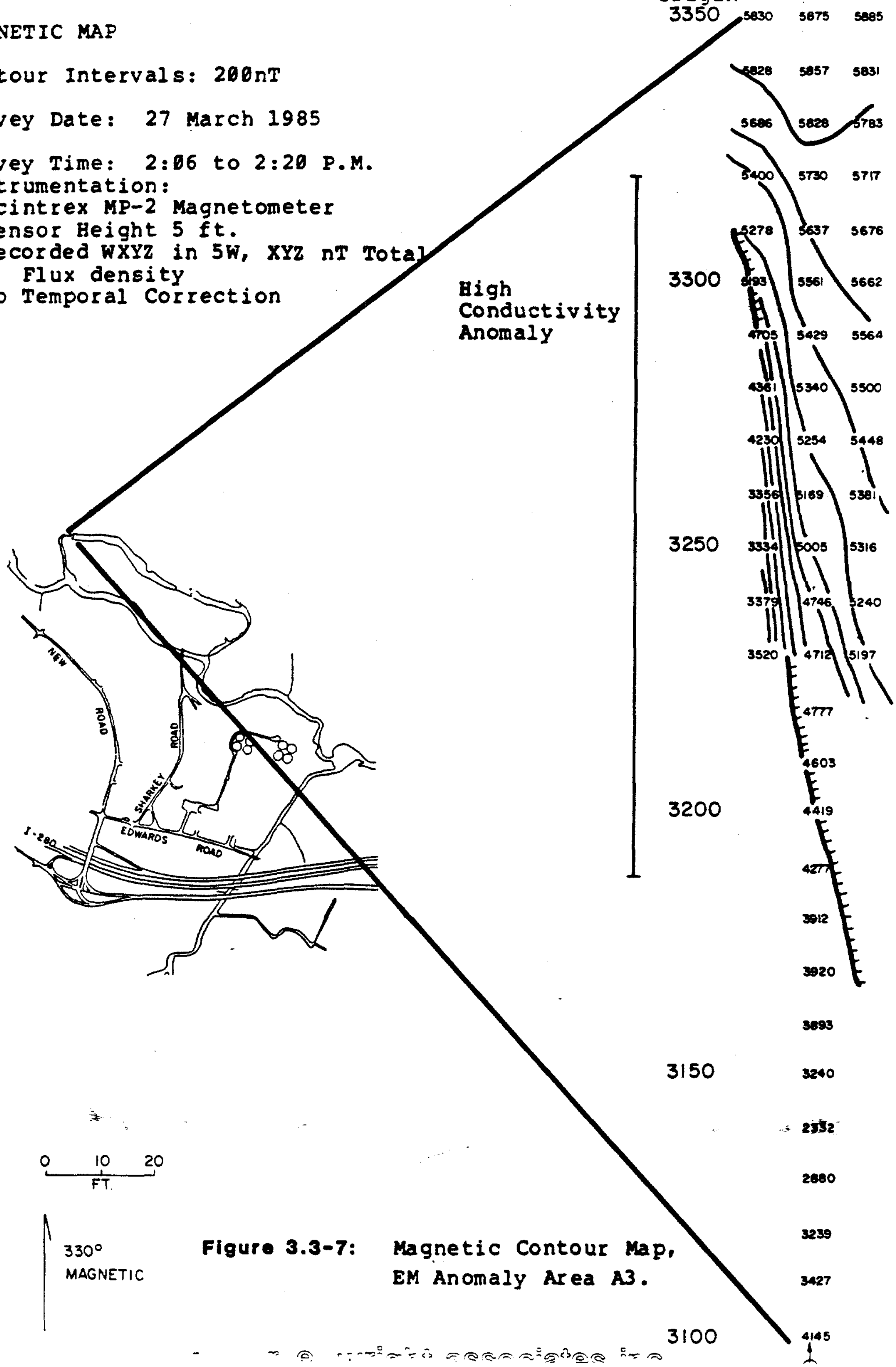
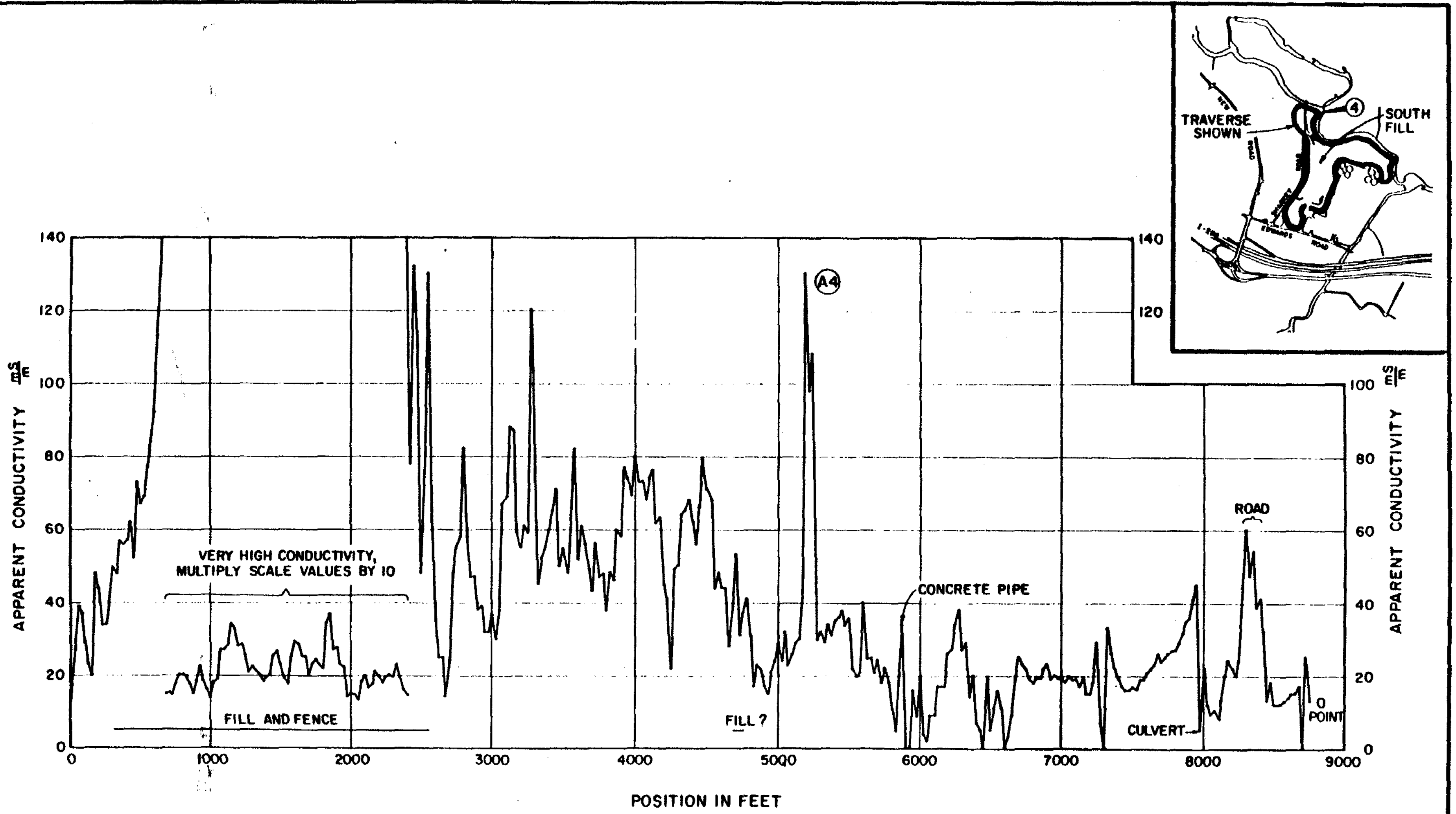


Figure 3.3-7: Magnetic Contour Map, EM Anomaly Area A3.



(A4) ELECTROMAGNETIC ANOMALY

SHARKEY LANDFILL

ELECTOMAGNETIC CONDUCTIVITY - SOUTH FILL PERIMETER

drawn RAM | checked | date 7-17-85 | FIGURE 3.3-6

F. M. wright associates, inc. earth resources consultants magnitude, shown on this figure occurs between the traverse positions of 5ØØ to 25ØØ feet. These EM values were the highest observed anywhere on the Sharkey site. Due, however, to the close proximity of the landfill fence, sewage treatment plant structures and obvious landfill cover as indicated by a topographical mounding, these and other interferences would mask any possible detection of leachate. This area is possibly a major repository for metallic materials landfilled here. With the exception of Anomaly A4, other conductivity peaks, shown on Figure 3.3-8, were obtained in areas obviously underlain by fill, or are characteristic of fill-induced EM-31 responses.

3.3.2.2.1 Anomaly A4 - The most significant anomaly in terms of potential leachate discovery is labeled Anomaly A4 on Figure 3.3-8. Subsequent magnetometer observations in the immediate vicinity of Anomaly A4, shown on Figure 3.3-9, indicated that a buried metallic mass in this area was probably responsible for the EM anomaly.

3.3.2.3 Line EM-1 - Figure 3.3-1Ø shows electromagnetic potentials found on the traverse paralleling the Whippany River to the south of the sewage treatment plant. Although several anomalous features appear, these do not suggest the presence of leachate. The shape of the anomalies present strongly indicated the influences of fill material.

3.3.2.4 Northwest and Southwest Fill Perimeters - Figures 3.3-11 and 3.3-12 show the results of EM traverses in the Northwest and Southwest Fill areas located south of I-28Ø. In both cases, there were no anomalous conductivity readings that could not be readily attributed to features at the surface, such as exposed metals and fill materials.

ANOMALY 4

MAGNETIC MAP

Contour Intervals: 50nT

Survey Date: 27 March 1985

Survey Time: 11:23 to 11:40 A.M.
Instrumentation:
  Scintrex MP-2 Magnetometer
  Sensor Height 5 ft.
  Recorded WXYZ in 5W, XYZ nT Total
    Flux density
  No Temporal Correction

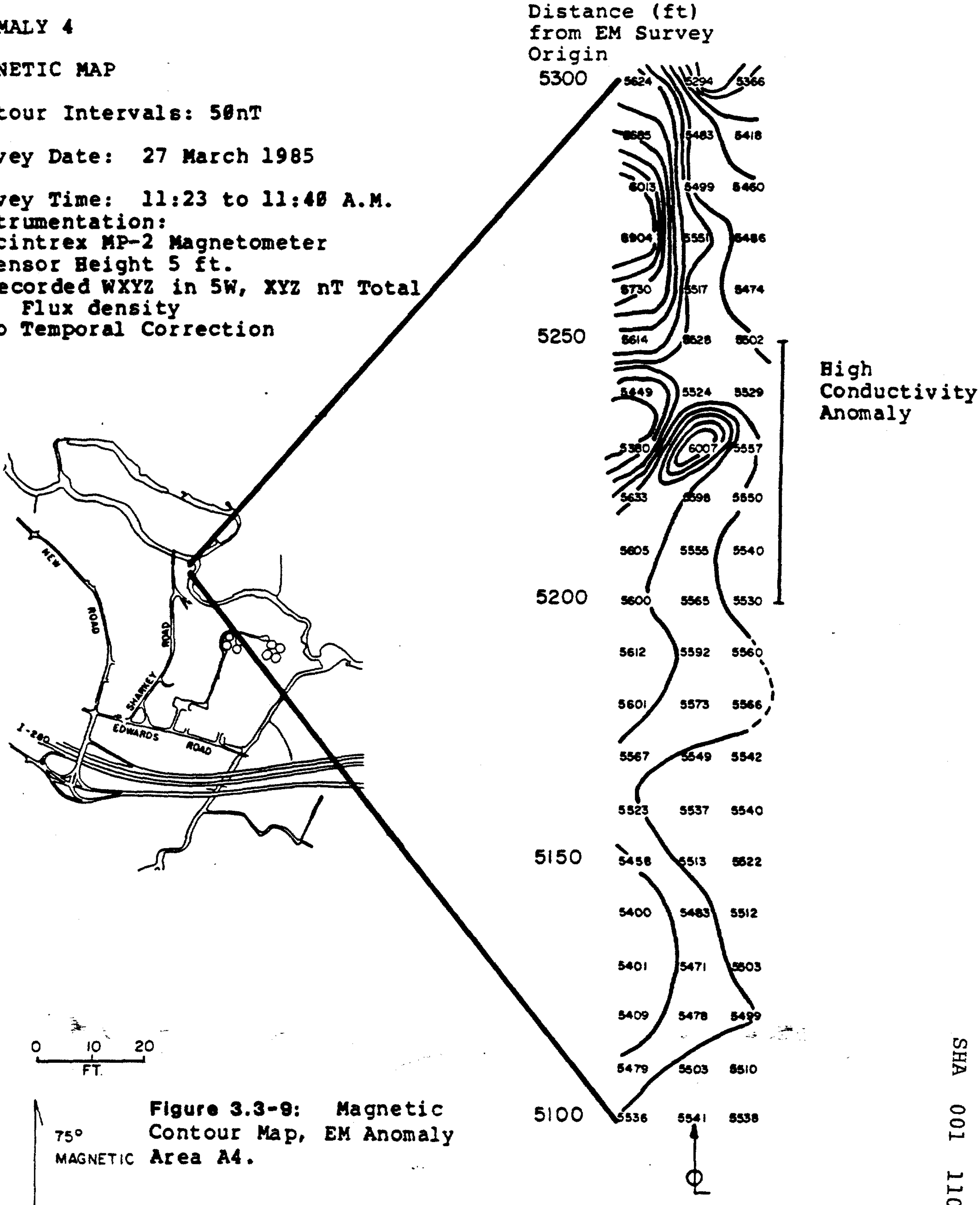
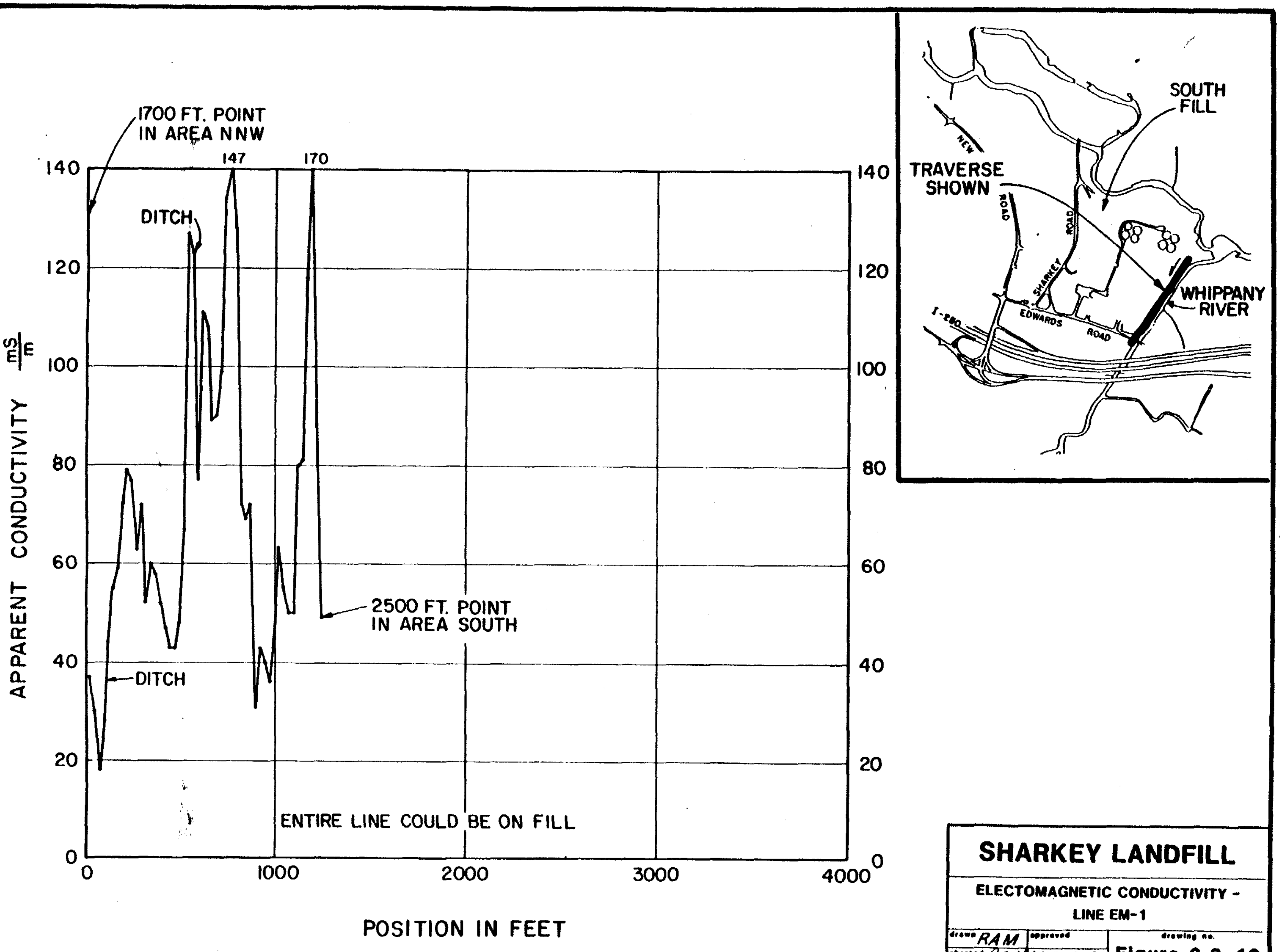


Figure 3.3-9: Magnetic Contour Map, EM Anomaly Area A4.



SHARKEY LANDFILL

ELECTOMAGNETIC CONDUCTIVITY - LINE EM-1

drawn RAM	approved	drawing no.
checked RAH	date 7-18-85	Figure 3.3-10

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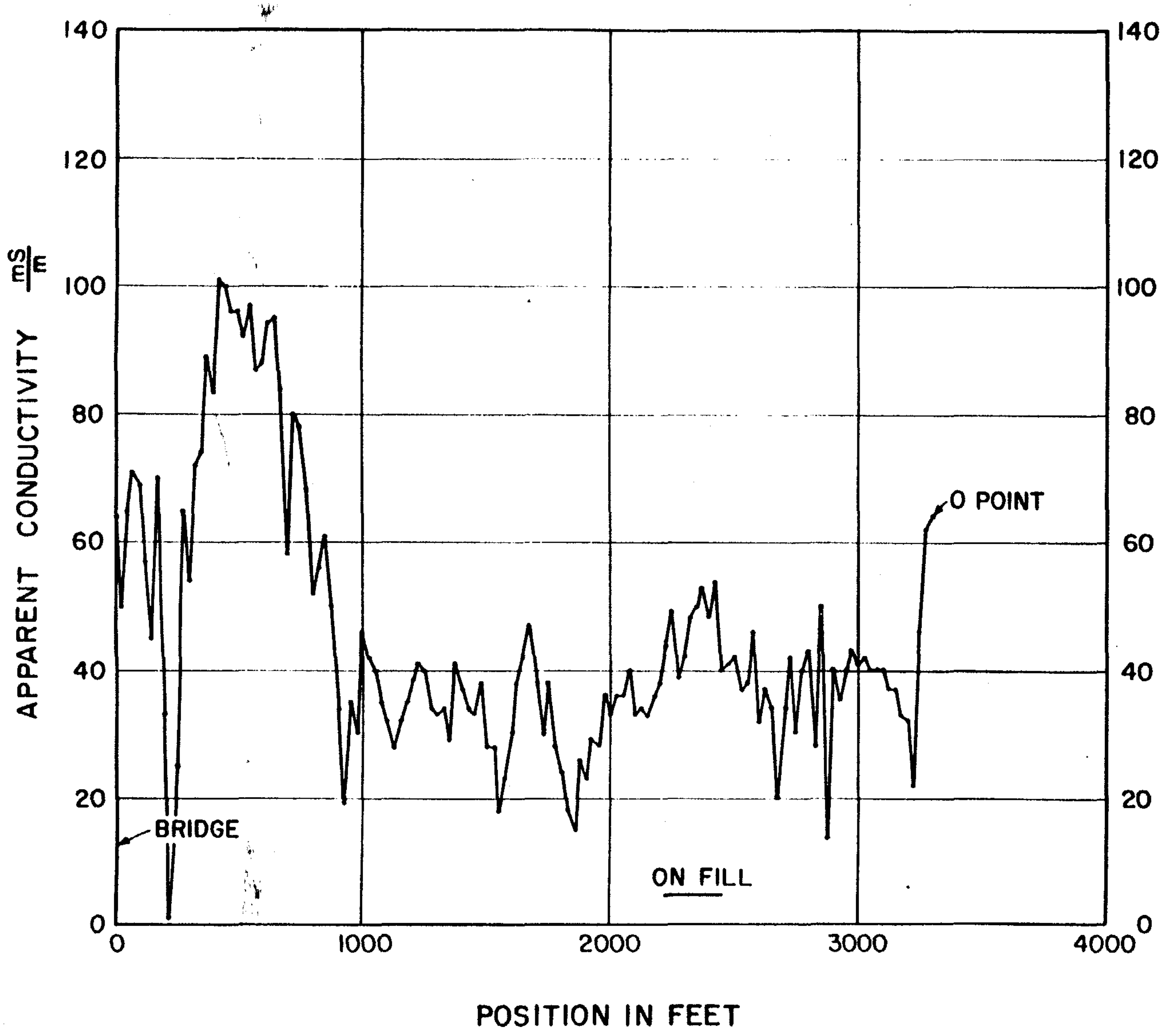

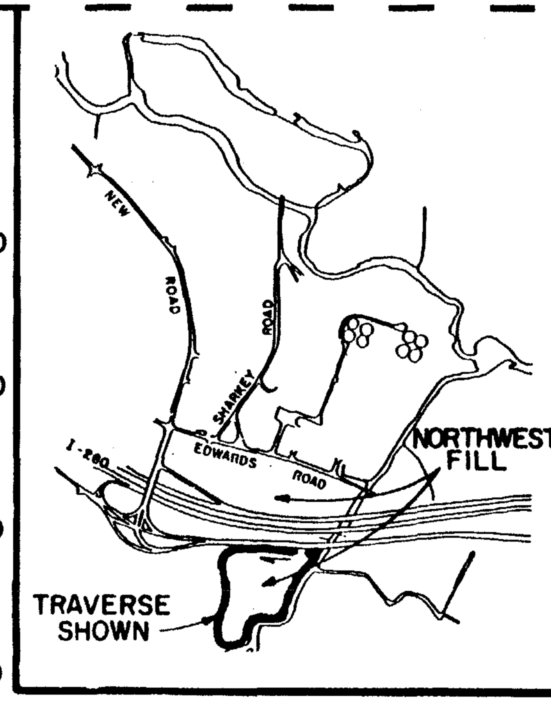

SHARKEY LANDFILL

ELECTOMAGNETIC CONDUCTIVITY - NORTHWEST FILL (B) PERIMETER

drawn RAM	approved	drawing no.
checked	date 7-18-85	**Figure 3.3-11**

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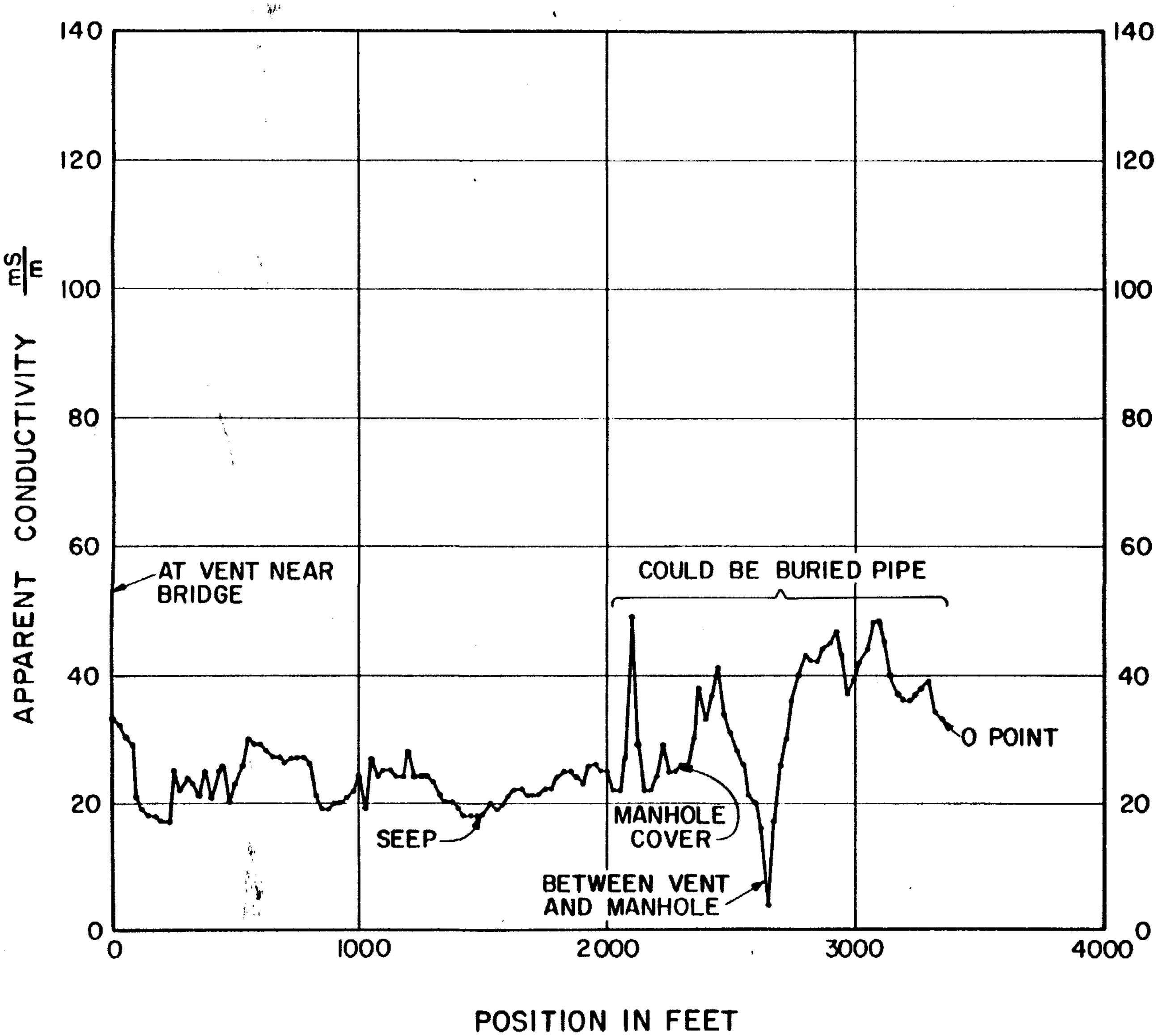

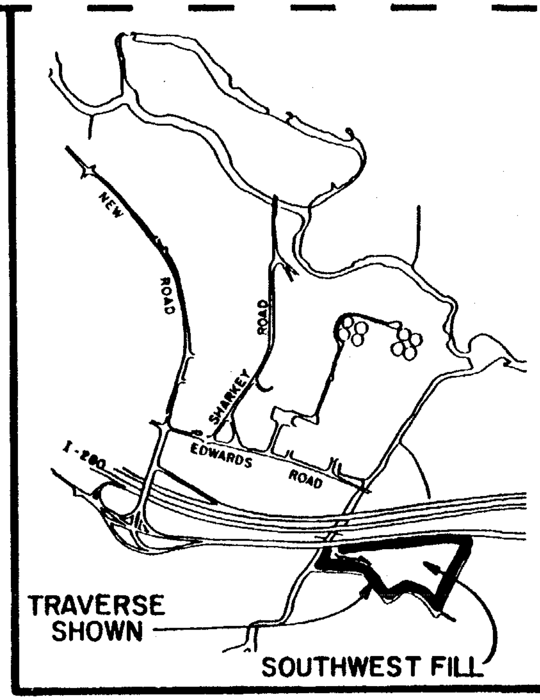

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SHARKEY LANDFILL

ELECTOMAGNETIC CONDUCTIVITY - SOUTHWEST FILL PERIMETER

drawn RAM	approved	drawing no.
checked	date 7-19-85	**Figure 3.3-12**

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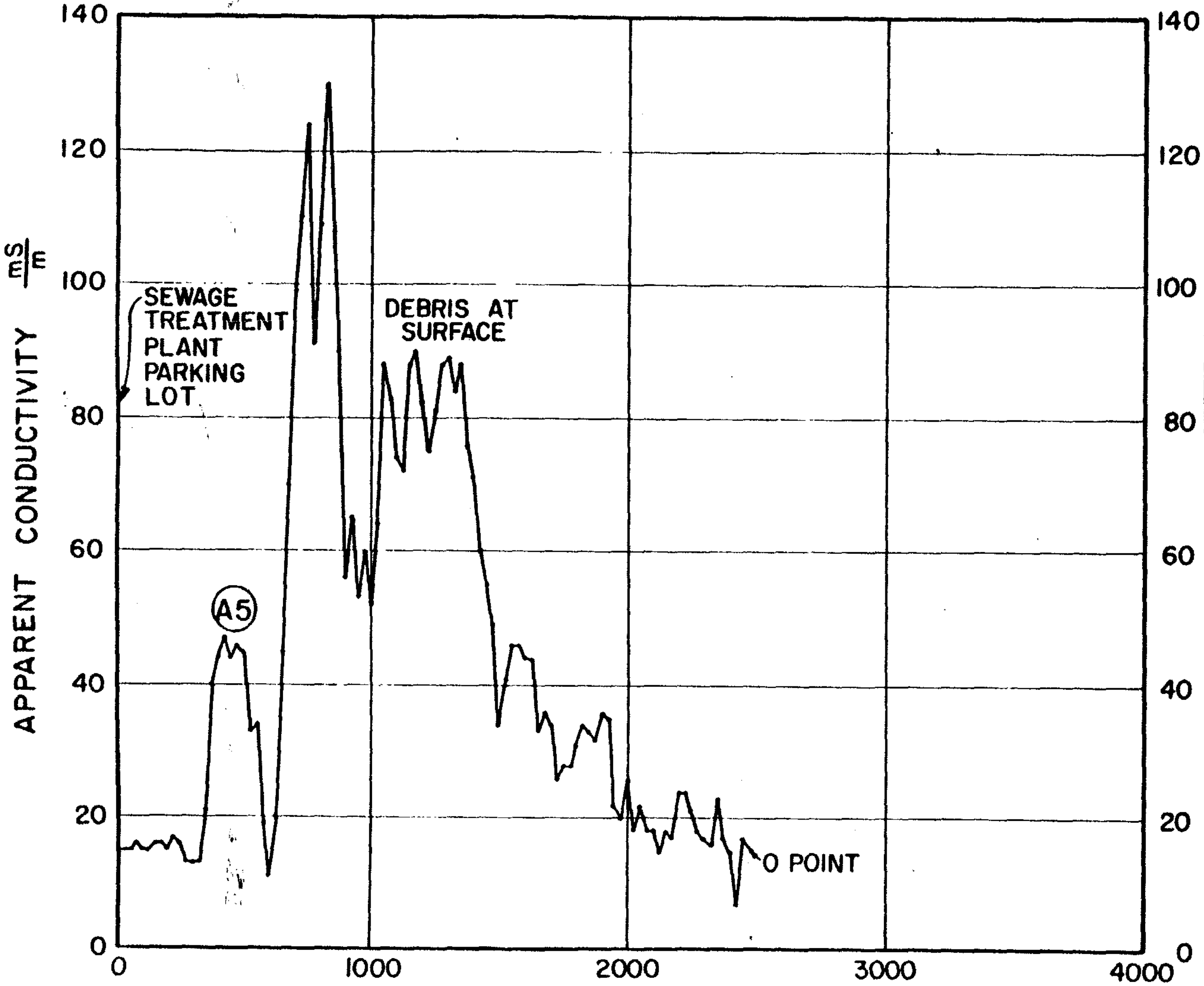
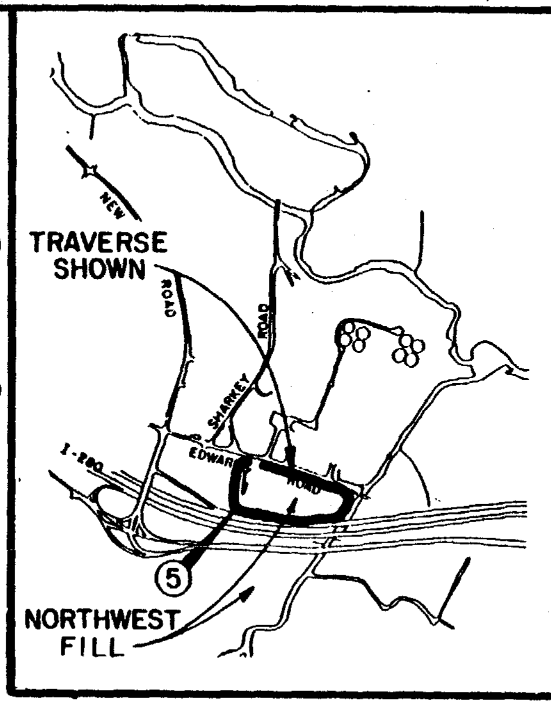
A seemingly significant electromagnetic feature, Anomaly A5, was discovered on the Northwest Fill, northeast of I-28Ø. This is shown as "Northwest Fill A" on Figure 3.3-13. The shape of the conductivity curve, particularly the breadth of the anomaly, suggests that a subsurface plume of conductive contaminants may be present beneath this area. A magnetic survey was therefore performed.

3.3.2.4.1 Anomaly A5 - The ground surface in the vicinity of Anomaly A5 is flat and very little fill is visible at the surface, indicating a potential subsurface source for the observed EM anomaly. The magnetic survey data shown on Figure 3.3-14, indicates that the area contains large quantities of buried iron. To further delineate this metallic influence, a magnetic survey line was completed perpendicular to the base magnetic survey lines and the EM survey line, at EM Survey Position 45Ø feet. The results show a gradual transgression from the EM anomaly area, progressing to a relative magnetic low, which is a typical response near the outer edge of a metallic mass. The marked rise in magnetic readings (to 56,76Ø nT) at EM Survey Position 45Ø feet (EM Anomaly A5 area) indicates the increasing proximity of massive iron influence.

The known presence of fill in this area and the close proximity of I-28Ø provide sufficient cause for EM and magnetometer anomalies at this location. Due, however, to the observed wetness of this general area, the potential influence of leachate on the data recorded cannot be dismissed.





(A5) ELECTROMAGNETIC ANOMALY

SHARKEY LANDFILL

ELECTOMAGNETIC CONDUCTIVITY - NORTHWEST FILL (A) PERIMETER

drawn RAM	approved	drawing no
checked	date 7-19-85	Figure 3.3-13

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ANOMALY 5

MAGNETIC MAP

Contour Intervals: 20nT

Survey Date: 27 March 1985

Survey Time: 9:59 to 10:19 A.M.

Instrumentation:
- Scintrex MP-2 Magnetometer
- Sensor Height 5 ft.
- Recorded WXYZ in 5W, XYZ nT Total Flux density
- No Temporal Correction

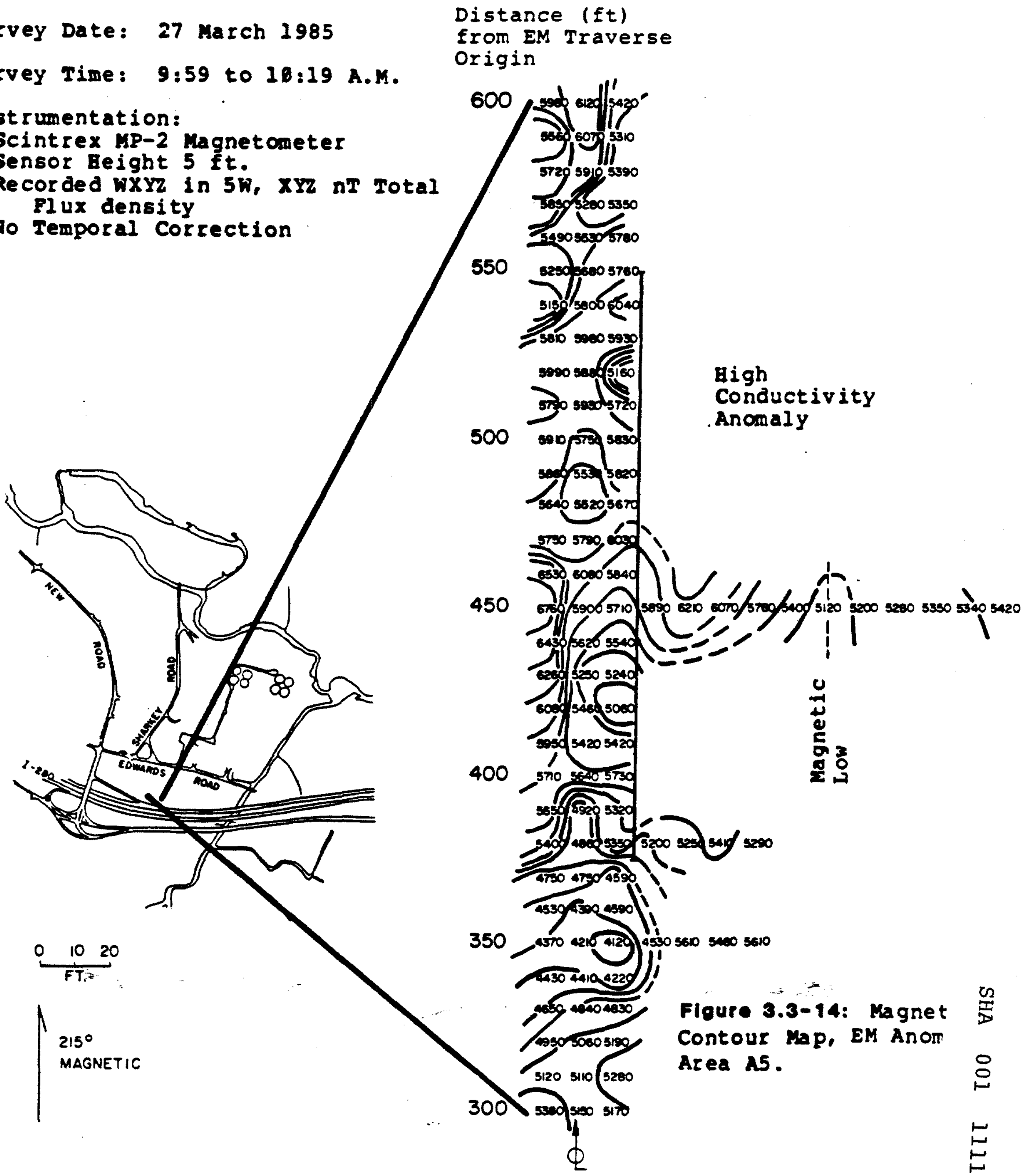

Figure 3.3-14: Magnet Contour Map, EM Anom Area A5.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Summary and Conclusions

4.1.1 Field Investigations - Physical Characterization Of The Site

1. Twenty-six monitoring wells were installed at the Sharkey Landfill Site between July 29 and October 23, 1985.

2. On the basis of information obtained from the completion of the monitoring wells, five distinct saturated deposits (strata) were identified beneath the study area. These include:

   - Fill
   - Upper Alluvial Deposits
   - Gray Varved Clay
   - Lower Glacial Outwash Deposits
   - Bedrock

3. Constant head permeability tests conducted on Shelby tube samples obtained from the varved clay unit indicated that the unit has an average permeability of approximately 1.3×10^{-7} cm/sec or 2.8×10^{-3} gpd/ft^2.

4. Geophysical logs were obtained for each of the 26 monitoring wells completed. These logs include gamma ray, density, and caliper. In addition, a temperature log was performed at each well site where the lower SHA 001 1112

glacial outwash aquifers was penetrated and in three shallow wells on the North Fill area.

5. The combination of geophysical logs, monitoring well drilling logs, and logs from previous foundation borings confirm the existence of a continuous, mappable, low permeability varved clay unit beneath the site. This unit separates the upper alluvial deposits from the lower glacial outwash deposits.

   A depression or trough has been delineated in the upper surface of the clay unit beneath the central portion of the Parsippany-Troy Hills Sewage Treatment Plant (STP).

6. It is possible that contaminant flow in the upper (shallow) aquifer traversing the North or South Fill area, especialy any contaminans of density greater than water, could become entrapped within this depression.

7. The overall thickness of the upper alluvial unit averages approximately 25 feet across the site.

8. Fill thicknesses on the North Fill vary from approximately 85 feet at the south end to about 45 feet at the north. On the South Fill, maximum fill thicknesses range from approximately 8Ø feet to the west of the Parsippany-Troy Hills STP to 65 feet on the northern perimeter of the STP.

9. The gray varved clay unit was apparently encountered during landfilling operations on both the North and

South Fill areas. There is no evidence that complete penetration of the clay unit has occurred.

Aquifer Testing

1. A shallow water table aquifer is present, separated from the lower confined aquifer by the gray varved clay unit. The shallow aquifer is present within the upper alluvial deposits and fill material. The lower aquifer occupies the lower glacial outwash materials between the varved clay deposit and bedrock.

2. Water level monitoring of the shallow aquifer has indicated that groundwater mounding is evident on the North Fill within topographically pronounced fill deposits. The lagoon near the southeastern corner of the STP appears to have caused mounding of the shallow aquifer water table due to infiltration of process water.

3. Shallow aquifer flow patterns indicate that the flow direction in this aquifer is generally toward the Rockaway and Whippany Rivers.

4. The water level data obtained from the lower aquifer suggests that the flow system for this aquifer is not in unison with the upper shallow aquifer in terms of flow direction. The flow pattern in the lower aquifer appears to diverge to the northwest and southeast from the vicinity of the sewage treatment plant. Furthermore, the overall piezometric relief of the lower

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aquifer is very flat ranging in observed elevation differences across the site of only 1.25 feet.

Even minor localized fluctuation of the water levels observed in the lower aquifer could significantly alter the interpretation of the groundwater flow directions in the lower aquifer.

5. Slug tests were conducted on six shallow monitoring wells. The permeability values obtained for the shallow aquifer as a result of these tests indicate that permeabilities for the natural materials range between 1.6×10^{-4} cm/s and 1.1×10^{-2} cm/s. Permeabilities for fill material, as measured in two wells is approximately 5×10^{-3} cm/s.

6. Two pumping tests were conducted on wells completed in the lower aquifer: Wells WI-8 and WI-3.

7. Calculated aquifer storage coefficients suggests that the lower aquifer is a confined flow system with low potential for vertical flow.

8. The annualized rate of groundwater discharge from the North Fill within the shalow aquifer to the Rockaway River is 51,75Ø gallons per day (gpd).

9. The annualized rate of groundwater discharge from the South Fill, Northwest Fill, Southwest Fill and STP lagoon infiltration to the Whippany and Rockaway rivers within the shallow aquifer is 2Ø5,ØØØ gpd.

1Ø. Leakage from the shallow aquifer to the lower aquifer is negligible, estimated at an annualized rate of only 1ØØ gpd.

4.1.2 Field Investigations - Chemical Characterization of the Site

4.1.2.1 Groundwater Sampling

1. A groundwater sampling program was completed to characterize the chemical contamination present beneath the site and in nearby wells. Each of the 26 monitoring wells, 1 public water supply well and 6 residential or commercially-used wells in the vicinity of the landfill were sampled.

2. There were no semi-volatile compounds detected in groundwater samples at levels exceeding the EPA Proposed Maximum Contaminant Levels or the NJDEP Interim Action Levels for drinking water supplies.

3. Two volatile organic compounds were found at concentrations exceeding the EPA Proposed Maximum Contaminant Levels and the NJDEP Interim Action Levels for drinking water supplies. These are benzene and trichloroethylene (TCE). Benzene was found in five shallow wells on the site: two on the North Fill, two on the South Fill, and one on the Northwest Fill. TCE also occurred in the well on the Northwest Fill.

The only intermediate-series well (lower aquifer) which exceeded these drinking water standards (for the compound benzene) was Well WI-17.

4. Most significant, in terms of inorganic contamination on site were the detection of cadmium, chromium, cyanide, lead and nickel. High levels of iron and manganese appeared to be common throughout the area.

5. The detection of cyanide remains questionable due to the detection of the compound in a field blank. The low level detection of cyanide in public water supply Well PW-305 (Homestead Avenue well) in East Hanover Township should be reassessed.

6. Although the presence of cadmium, lead and nickel were generally above drinking water standards in the landfill, there does not appear to be an adverse effect on the Rockaway or Whippany Rivers downstream.

7. Although organic contamination has been detected in each fill area the levels of contamination do not appear to result in adverse effects on the quality of the adjacent Rockaway and Whippany Rivers.

There are no known drinking water sources or private wells within the area immediately downgradient from the landfill in the shallow aquifer. Therefore, the contamination noted does not appear to pose an immediate threat, under present water level distribution and pumping conditions.

8. Phenol levels are all below the NJPDES drinking water standard of 35ØØ ug/l. However, it was detected at many locations throughout the area, including the potable water supply wells. In view of fluctuation criteria for this contaminant, resampling of potential or drinking water sources in the area would be advisable to confirm the presence of the contaminant.

4.1.2.2 Soil Sampling

1. Five locations were selected in the landfill study area to obtain shallow soil samples for chemical analysis.

2. Seven organic compounds were identified in the soil samples. These include acetone, 2-butanone, naphthalene, phenanthrene, 2-methylnaphthalene, fluoranthene, and pyrene. Only acetone and naphthalene were also found in groundwater samples. However, there is no apparent direct correlation between locations of such soil and groundwater contamination.

4.1.2.3 Electromagnetic Survey

1. An electromagnetic survey was conducted to determine, if possible, the extent and relative degree of groundwater contamination and to aid in the location of shallow concentrations of leachate. Five anomalous electromagnetic conductivity areas were delineated during the electromagnetic survey. Subsequent magnetometer surveys of these five areas indicated that four of these anomalies were probably caused by buried iron mass. The soils from the remaining electromagnetic anomaly site were subsequently sampled and submitted for chemical

analysis. No significant detection of organic compounds was reported.

4.2 Recommendations

1. Adequate landfill cover, propagation of vegetative growth in abandoned landfill areas, and stabilization of landfill banks in the vicinity of the river channels should be given priority consideration in the selection of remedial alternatives.

2. Wells that revealed positive detections of cyanide should be resampled, particularly the East Hanover Township Homestead Avenue well.

3. Well WI-17 should be sampled and tested to confirm the presence of benzene and/or organic contaminants.

4. At least one well should be constructed in the central portion of the Parsippany-Troy Hills sewage treatment plant to explore the deepest area of the shallow aquifer in that vicinity. This well should be screened immediately above the varved clay unit. A water sample should be obtained from this well and analyzed for priority pollutants.

5. At least two additional wells should be constructed on the east side of the Rockaway River in Montville Township. These wells should be located in the marshy area to the south of the North Fill and to the northeast of the South Fill. The purpose of these wells is to further delineate the topography of the top of the clay unit. These wells should be screened at the top of the

clay unit and groundwater samples obtained for chemical analyses. The purpose of the analyses is to assess the potential for heavier than water contaminants migrating along the surface of this unit, eluding direct Rockaway river flow channel capture.

Due to the difficult access conditions in this area, selection of well construction sites cannot be determined until after field inspection.

EPA REGION II
SCANNING TRACKING SHEET

DOC ID # 53761

DOC TITLE/SUBJECT:

SHARKEY FARMS LANDFILL
NJ DEP – HAZARDOUS SITE MITIGATION ADMINSTRATION – MONITORING WELL LOCATIONS: JANUARY 1986 (PLATE 3)

THIS DOCUMENT IS OVERSIZED AND CAN BE LOCATED IN THE ADMINISTRATIVE RECORD FILE AT THE

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4. SURFACE WATER INVESTIGATION

This Chapter presents the results of two (2) water quality surveys conducted on the Rockaway and Whippany Rivers in the vicinity of the Sharkey Farms Landfill. This Chapter was prepared by Hydroqual, Inc. who were the water quality consultants and conducted the water quality surveys. The study included sampling and analysis of the rivers, river sediments and leachates from the Sharkey Site. The contents of this Chapter include the results of the dry weather and wet weather surveys and the study's conclusions and recommendations.

SECTION 4

DRY AND WET WEATHER SAMPLING SURVEYS OF SURFACE WATERS, LEACHATES AND SEDIMENTS

INTRODUCTION

Two surface water and leachate sampling surveys were conducted at the Sharkey Landfill site. The first, the dry weather survey, was conducted July 23 and 24, 1985, and included sediment sampling. The second, the wet weather survey, was conducted November 5, 1985, following and during a significant rainfall event in the area. The purpose of the investigation was to determine if contaminants were being released from the landfill to surface waters during dry and wet weather conditions.

This section presents the results of the two surveys including: measured river flows, field data collection observations, results of priority pollutant analysis, QA/QC review of the results, and conclusions relative to contamination of the surface waters and leachates.

SAMPLING LOCATIONS

Site reconnaissance surveys on September 18, 1984 and April 12, 1985, were conducted to locate sampling locations. Comments on the survey findings were included in the field sampling plan report dated June 12, 1985. The location of all the surface water, stream, sediment and leachate sampling locations are shown on the enclosed topographic map. Except for stations SD4 and SD9, sediments were collected at the same locations as water samples, during the dry weather survey only. Sampling locations are listed in Table 4-1.

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TABLE 4-1. SAMPLE LOCATIONS

		Survey Sampled	Comments
Whippany River	SD1	D, W	Upstream of site
	SD2	D	Mid-southwest fill area
	SD3	D, W	Above confluence with Rockaway River
Rockaway River	SD4	D, W	Upstream of site
	SD5	D	Downstream of north fill area
	SD6	D, W	Above confluence with Whippany River
	SD7	D, W	Downstream of site and treatment plant
Ponds	SD8	D	Adjacent to south fill
	SD9	D	Adjacent to south fill
	SD10	D	Ponds in north branch of Rockway
	SD11	D	River, no flow during dry weather survey period
Treatment Plant Effluent	PE	D, W	At confluence of Rockaway and Whippany Rivers
Leachates	L1o	D	Ditch southwest of fill
	L2o	D, W	Northwest fill B
	L5	D, W	Northwest fill A
	L3	D, W	Adjacent sewage treatment plant
	L4	D	Adjacent sewage treatment plant
	L6	W	North fill
	L8	W	North fill

SAMPLING PROCEDURES

The procedures specified in the Field Sampling Plan were followed to sample the surface water, sediments, and leachates. Dedicated stainless steel two gallon buckets were used, one for each surface water, leachate, and plant effluent sample. Dedicated stainless steel core devices were used to sample the river sediments. A two gallon grab sample of the water was collected at each station and split into 1 liter bottles that contained the specified preservatives for the priority pollutant analysis including: acid-base neutral

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compounds (ABNs), pesticides and PCBs, metals, phenols, and cyanides. Precleaned glass funnels (one per sample location) were used to pour the sample from the stainless steel bucket to the separate 1 liter bottles. Three 40 ml vials were used to collect samples for the volatile organics. Samples at each station were placed in separate coolers which were iced and delivered to U.S. Testing's laboratory in Hoboken, New Jersey the following morning. One trip blank and one field blank were included. The field blank was developed by pouring a two-gallon sample of laboratory water from U.S. Testing into one of the stainless steel buckets, and then into the sample bottles. All sample bottles and dedicated sampling containers had been precleaned according to procedures in the FSP. The total number of samples collected and analyzed were:

	Dry Weather Survey	Wet Weather Survey
Surface Water		
Water Column	9	5
Sediment	9	-
Leachates	4	5
Sewage Plant Effluent	1	1
Field Blank	1	1
Trip Blank	1	1
	25	13

DRY WEATHER SURVEY JULY 23 AND 24, 1985

River flow measurements and a reconnaissance of sampling locations were performed on July 23 and the sampling of surface waters, sediments, and leachates was performed on July 24.

River Flows

Streamflow measruements based on measured cross-sectional area and velocity, were made at Station SD4 and SD6 on the Rockaway River and Stations SD1 and SD3 on the Whippany River. The measured flows were as follows:

Measured Flow (cfs)
(July 23, 1985)

	Location	Rockaway River	Location	Whippany River
Flow (cfs)	SD4	21	SD1	43
Flow (cfs)	SD6	27	SD3	41
Average Flow (cfs)		24		42
Drainage Area at Flow Measurement Location (sq. miles)	SD4	136	SD3	69
Calculated cfs/square mile July 23		0.15		0.6

United States Geological Survey (USGS) flow data from gaging stations on the Rockaway, Whippany and Passaic Rivers were reviewed to determine the surface water flow variability prior to the survey and for comparison with measured flows. The gaging stations are located on the Rockaway River downstream of the Boonton Reservoir, the Whippany River at Morristown, and the Passaic River at Chatham, upstream of the confluence of the Rockaway and the Passaic Rivers. Gaging station flows during this period are shown on Table 4-2.

TABLE 4-2. USGS GAGING STATION DATA (cfs)

Date (1985)	Rockaway River at Boonton	Whippany River at Morristown	Passaic River at Chatham
July 17	11	19	41
July 18	11	17	32
July 19	11	16	29
July 20	11	15	-
July 21	11	15	-
July 22	11	33	37
July 23	11	17	30
July 24	11	15	26
Drainage area at Gage (square miles)	119	29.4	100
Calculated cfs/square mile on July 23	0.1	0.6	0.3

The Rockaway River flow which was controlled at the Boonton Reservoir, was constant at 11 cfs through the period July 16 to July 24. An average flow of 24 cfs was measured downstream at the Sharkey Landfill site. The Whippany River flow ranged from 15 to 33 cfs during the same period. The upstream gaged flow was 17 cfs on July 23 compared to the 42 cfs measured at the Sharkey Landfill site at SD3, the difference directly proportional to the respective drainage areas. Undoubtedly, an 0.15 inch rain on July 20 to July 21 caused the flow increase observed in the Whippany River on July 22. The Passaic River flow at Chatham ranged from 26 to 41 cfs during this period and was 30 cfs on July 23. The flow per unit contributing drainage area on July 23 was 0.6 cfs/square mile for the Whippany at both locations, and 0.3 cfs/square mile for the Passaic River. The Rockaway flow was lower, 0.1 to 0.15 cfs/square mile, probably due to accumulation in the reservoir. A relatively steady dry weather flow existed prior to the survey on July 24. These river flows represent a relatively low flow condition. Flows lower than these occur approximately 25 percent of the time according to the USGS gaging records. The annual average flows at the three gaging stations are 136 cfs for the Rockaway River, 52 cfs for the Whippany River and 170 cfs for the Passaic River at Chatham.

Field Data Collection

Field measurements were made the day of the survey at all sampling locations for water temperature, dissolved oxygen concentration, pH, and specific conductance. In addition, samples were collected and analyzed for total dissolved solids (TDS) and chlorides. The data are presented in Table 4-3. The river water temperature averaged 21.6°C. Dissolved oxygen concentrations were approximately 5.5 mg/l in the Whippany River, and averaged 3.5 mg/l in the Rockaway River. These are relatively low compared to the theoretical saturation value of approximately 8.8 to 9.0 mg/l at 21 to 22°C. Leachate dissolved oxygen concentrations were also low. The pond's pH values were slightly greater than 8.0. The high dissolved oxygen observed in the ponds was indicative of algal photosynthetic activity. Specific conductance ranged from 430 to 790 micromhos/cm in the river samples and 495 to 1470 in the leachates. The TDS

TABLE 4-3. DRY WEATHER SURVEY FIELD DATA SUMMARY
(July 24, 1985)

	Time	Temperature (^{o}C)	Dissolved Oxygen (mg/l)	pH	Specific Conductance (µmhos/cm)	TDS (mg/l)	Chlorides (mg/l)
Whippany River							
SD1	0900	20.5	4.6	7.4	790	266	59
SD2	1000	20.5	5.3	7.34	500	248	53
SD3	0900	21.0	5.5	7.1	470	256	53
Leachates							
L1o	1120	22.0	5.6	7.76	495	308	43
L2	1045	15.5	2.4	6.65	1470	744	220
L3[a]	1600	26.0/26.0	2.2/2.6	7.0/7.03	1000/1000	521	110
L5	1200	26.2	4.0	7.1	800	476	84
Rockaway River							
SD4	1400	22.8	3.6	7.12	450	200	50
SD5	1710	22.0	2.5	7.0	470	203	50
SD6	1120	23.0	3.1	6.85	430	192	47
SD7	1015	21.5	5.0	7.05	510	273	60
Plant Effluent	1525	25.5	6.0	7.0	770	511	110
Ponds[b]							
SD8	1330	28.0	9.7	8.1	225	103	24
SD9	1330	28.0	9.2	-	-	-	-
SD10	1505	27.0	10.3	8.4	520	271	61
SD11	1505	31.0	15.8	-	-	-	-
Field Blank	1700	26.0	7.4	7.5	3	6	<5.0

[a] Duplicate measurements were made
[b] pH and specific conductance were measured on composite samples of SD8 and SD9 and SD10 and SD11

concentrations ranged from 192 to 266 mg/l in the rivers and 308 to 744 mg/l in the leachates. The chloride concentration ranged from 47 to 60 mg/l in the rivers and from 43 to 220 mg/l in leachate samples. Leachate at station 2o had the highest specific conductance, TDS and chlorides concentration. Ponds 8 and 9 had lower TDS concentrations than the Rockaway River, while Ponds 10 and 11, which were located in the northern branch of the Rockaway River which was not flowing during the survey, had somewhat higher TDS than the Rockaway River.

A mass balance based on flow, TDS and chlorides was computed at the confluence of the Whippany and Rockaway Rivers to determine if the combined TDS and chloride loads at SD3, SD6 and PE agreed with the TDS and chlorides load at measured location SD7 downstream, which included the three flows. The following balance was computed.

	Flow	TDS		Chlorides	
	(cfs)	mg/l	lbs/day	mg/l	lbs/day
SD3 (Whippany)	42	256	58,060	53	12,020
SD6 (Rockaway)	27	192	27,995	47	6,855
PE (Plant Effluent)	11.5	511	31,735	110	6,830
Total	80.5		117,790		25,705
SD7 (Rockaway)	80.5	273	118,673	60	26,080
Percent Difference			<1		1.5

The calculated TDS and chloride loads at SD7 showed good agreement with that computed by adding the loads from the rivers and treatment plant, indicating that the flow measurements were balanced. The leachate flows were too low to result in any significant increase in TDS and chlorides concentrations between sampling stations in the Whippany River, thus a TDS/chlorides balance attempted was unsuccessful in determining leachate flows.

Field Observations

The following field observations and notes were made during the dry weather survey:

L1o Very low flow, estimated at less than 1 gpm. This leachate had some yellowish orange tint and no noticeable odor.

L2o Very low flow estimated at less than 1 gpm. Water was very clear, there was some chemical odor noticeable and what appeared to be an orange color iron bacterial slime present in the area on rocks and on the surface of the water.

L4 L3 was not flowing; L4 leachate flow was estimated at 2 to 3 gpm. The leachate was very clear and had no odor. An iron bacteria slime was attached to rocks in the area. This leachate may originate from the scrubber water ash ponds at the treatment plant.

L5 Very low flow, less than 1 gpm; no odor, iron bacteria in area, and some oil on the surface of this drainage ditch. There was a lot of broken glass in the sediment in this drainage ditch.

Other pertinent field observations and notes include the following:

SD4 Soft muddy bottom south of Route 46 bridge. A sediment sample was collected here. Since the bottom was disturbed during the sediment sampling and the river was too deep to wade out into the river any further, the water column sample was obtained further upstream above the second bridge.

SD10 Pond was approximately six feet deep at the sampling location. Water had a greenish appearance indicative of algae.

SD11 Pond was approximately one foot deep at sampling location. Water had greenish appearance indicative of algae.

SD8 Pond was approximately 3.5 feet deep in center where samples were collected. Attached bottom growth was observed in the pond.

SD9 Pond was approxiately 10 feet deep in center where samples were collected. Sediment sample was collected closer to banks at one to two feet water depth.

PE The treatment plant effluent was very clear. A grab sample was collected at the chlorine contact chamber effluent. Plant flow was 7.4 mgd (11.5 cfs), on July 23, 1985.

The area at the north end of the north fill was inspected to observe the erosion of the landfill banks in this area. Several pictures of this area were taken and are included. The eroded area is also noted on the topographic map. This eroded area has vey steep banks from the landfill to the Rockaway River. The banks are exposed with no cover material. Plastic bags, bottles, and tires were noticeable and had also accumulated in the Rockaway River right downstream of the North Fill bridge.

Analytical Results

A 10 volume report from U.S. Testing comprised of approximately 2500 pages, was received on October 18, 1985. A review of the data and the QA/QC backup information was performed by HydroQual and its laboratory, General Testing. Mr. Richard Scheible, the QA/QC Project Officer for this project, conducted the review. The review of the initial submittal raised a number of questions which were discussed with U.S. Testing Laboratory personnel. An addendum report (Volume XI) prepared by U.S. Testing, addressed the QA/QC comments, and provided data corrections and clarifications. The report was submitted to HydroQual on November 21, 1985. The QA/QC reviews, U.S. Testing's responses, and followup reviews of repeat analyses are included in the end of this chapter. The analytical results from the report are summarized in Tables 4-4 to 4-6. These tables present concentrations of organic and inorganic priority pollutants, tentatively identified organics and other parameters detected in the samples, the reagent blank water used in the laboratory and the trip and field blanks.

TABLE 4-4. VOLATILE ORGANIC CONCENTRATIONS IN SURFACE WATERS, SEDIMENTS, AND LEACHATES FOR DRY WEATHER SURVEY OF JULY 25, 1985

Volatile Organic Compounds	Reagent Blanks Water 1	Reagent Blanks Water 2	Reagent Blanks Soils 1	Reagent Blanks Soils 2	Field Blank	Trip Blank	Water Column Samples (SW) 1	2	3	4	5	6	7	869	10611	Sediment Samples (SD) 1	2	3	4	5	6	7	869	10611	Leachate Samples (L) 1o	2o	3&4	5	P.E.
Priority Pollutants																													
Methylene Chloride	9	6	-	1J	2JB	3J	-	2JB	2JB	12B	2JB	1JB	3JB	8B	2JB	-	-	2JB	-	1JB	2JB	-	6B	940JB	2JB	2JB	2JB	7B	3JB
Trichloroethene	1	2	130	-	1JB	1J	-	1JB	1JB	1JB	1JB	1JB	1JB	1JB	1JB	-	-	1J	1J	-	-	-	1J	310J	1JB	1JB	1JB	1JB	1JB
Chloroform	-	-	-	-	-	-	-	-	-	1J	1J	1J	3J	-	-	-	-	-	-	-	-	-	-	-	-	-	1J	-	27
Tetrachloroethene	-	-	250	-	-	-	-	-	-	-	2J	2J	-	-	3J	-	-	-	-	-	-	-	-	940J	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	3J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1J	1J	-	-
Bromodichloromethane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
Dibromochloromethane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
Chlorobenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-
Trans-1,2-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1J	-	-
Other and Tentatively Identified Compounds																													
Acetone	10	-	-	41	15	-	-	10B	6JB	-	15	11	9J	15B	9J	-	-	16B	-	15B	13B	-	-	940JB	-	8J	-	-	-
Carbon Disulfide	-	-	-	-	-	-	-	-	-	5	-	-	4J	-	-	-	-	-	-	-	-	-	-	-	-	4J	-	-	-
2-Hexanone	-	-	250	-	-	-	8J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11B	-	-
4-Methyl-2-Pentanone	-	4	130	-	-	-	4J	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3JB	-	-
Styrene	-	-	130	-	-	-	-	-	-	4J	-	-	-	-	-	-	-	2J	2J	3J	3J	3J	2J	310J	-	-	-	-	-
Total Xylenes	-	-	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	5	4J	-	6	3J	310J	-	-	-	-	-
2-Propanone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-	-	24	-	-	-	-	-	-	-
2-Propanol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	-	-	-	-	-	-	-	-	-	-
Nonane	-	-	780	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	17	23	17	1300	-	-	-	-	-
Dimethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-
Unknown VOAs 255	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-	-	-	-	-	-	-	-	-	-
47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46	-	-	-	-	-	-	-	-	-	-	-	-
74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-	-	-	-	-	-	-	-	-	-	-
123	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	-	-	-	-	-	-	-	-	-	-	-	-	-
261	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	99	-	-	-	-	-	-	-
390	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-
399	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-
863	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	-	-	-	-	-	-	-	-
882	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-
908	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
909	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
926	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-
937	-	-	-	-	-	-	-	4	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
938	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-
967	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-	-	13	-	-	-	-	-	-	-	-	-
968	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-	-	-
1062	-	-	2730	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1800	-	-	-	-	-
1063	-	-	-	-	-	34	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	8	-	-	-	23	-	-
1064	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1065	6	6	-	-	19	-	10	5	6	-	7	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-
1066	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	-	-	-	-	-	-	-
907	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	-	-	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
234	-	-	-	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
406	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: All concentrations expressed in micrograms per liter (ug/l), except for sediments which are expressed in micrograms per kilogram dry weight (ug/kg)

Tentatively identified compound based on scan number (non-priority pollutants) estimated concentrations.

J - an estimated value.

B - Analyte was found in blank as well as sample. Indicates possible/probable blank contamination

P.E. - Wastewater plant effluent

SHA 001 1132

TABLE 4-5. ACID BASE NEUTRALS AND PESTICIDE/PCB CONCENTRATIONS IN SURFACE WATERS, SEDIMENTS, AND LEACHATES FOR DRY WEATHER SURVEY OF JULY 24, 1985

ABNs	Reagent Blanks Water 1	Water 2	Water 2	Soils 1	Soils 2	Field Blank	Water Column Samples (SD) 1	2	3	4	5	6	7	8&9	10&11	Sediment Samples (SD) 1	2	3	4	5	6	7	8&9	10&11	Leachate Samples (L) 1a	2a	3&4	5	P.E.
Priority Pollutants																													
Di-N-Butylphthalate	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2J	-	-
Bis (2-Ethylhexyl)Phthalate	-			-		-	-	-	-	-	-	-	-	-	-	100J	-	370	370	170J	-	-	-	230J	-	-	2J	14J	-
Phenanthrene	-			-		-	-	-	-	-	-	-	-	-	-	-	-	270J	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	-			-		-	-	-	-	-	-	-	-	-	-	-	-	670	200J	-	-	-	-	-	-	-	-	-	-
Pyrene	-			-		-	-	-	-	-	-	-	-	-	-	-	-	200J	66J	-	-	-	-	-	-	-	-	-	-
Benzo (a) Anthracene	-			-		-	-	-	-	-	-	-	-	-	-	-	-	200J	-	-	-	-	-	-	-	-	-	-	-
Benzo (k) Fluoranthene	-			-		-	-	-	-	-	-	-	-	-	-	-	-	330	-	-	-	-	-	-	-	-	-	-	-
Tentatively Identified Compounds																													
1-Pentene, 2-Methyl	-			-		-	84	-	-	-	-	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethene, Tetrachloro	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	9
4-Hydroxy-4-Methyl-2-Pentanone	-			-		200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfur, Mol (S8)	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	854	-	-	-	-	-
Unknown ABNs 190	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	-	-
191	-			-		-	-	-	-	-	135	-	-	-	142	-	7392	16940	12705	9108	880	-	22587	6830	-	-	-	-	-
192	-			-		-	-	-	-	-	-	-	-	97	-	-	-	-	-	-	-	14426	-	-	70	-	-	-	-
193	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	19
194	-			-		-	-	-	82	-	-	-	115	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
196	-			-		-	-	153	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
197	-			-		-	-	-	-	93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
198	-			-		-	-	-	-	-	-	-	-	-	-	670	-	-	-	-	-	-	-	-	-	-	-	-	-
199	-			1620		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
201	26			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
204	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	-	-	-
220	-			2000		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
222	-			-		-	-	-	-	-	-	-	-	-	-	178	-	-	-	-	-	-	-	-	-	-	-	-	-
309	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-
320	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
330	-			-		-	-	-	-	-	-	-	-	-	-	400	-	-	-	-	-	-	-	-	-	-	-	-	-
340	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	3498	-	-	-	-	-	-	-	-	-
342	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3771	2933	-	-	-	-	-	-	-
344	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3206	-	-	-	-	-	-	-	-
345	-			-		-	-	-	-	-	-	-	-	-	-	-	-	4950	4620	-	-	-	-	4247	-	-	-	-	-
350	-			-		-	-	-	-	-	-	-	-	-	-	-	3762	-	-	-	-	-	-	-	-	-	-	-	-
358	-			-		260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
459	-			-		-	-	-	-	-	-	-	-	-	-	1351	-	-	-	-	-	-	-	-	-	-	-	-	-
477	-			-		-	-	-	-	-	-	-	-	-	-	-	10164	-	-	-	-	-	-	-	-	-	-	-	-
480	-			-		-	-	-	-	-	-	-	-	-	-	-	-	9130	-	-	-	-	-	-	-	-	-	-	-
485	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	10164	-	-	-	-	-	-	-	-	-
488	-			-		80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11126	-	-	-	-	-	-	-
489	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	11798	-	-	-	9680	8379	-	-	-	-	-
492	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9680	-	-	8838	-	-	-	-	-
601	-			-		500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
910	-			-		-	-	-	-	-	-	-	-	-	-	62	-	-	-	-	-	-	-	-	-	-	-	-	-
939	-			-		-	8	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
975	-			-		-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1090	5			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1061	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-
1140	-			-		-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1141	-			-		-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1969	-			-		-	-	-	-	-	-	-	-	-	-	-	880	-	-	-	-	-	-	-	-	-	-	-	-
2068	-			-		-	-	-	-	-	-	-	-	-	-	-	1320	-	-	-	-	-	-	-	-	-	-	-	-
2226	-			-		-	-	-	-	-	-	-	-	-	-	-	2310	-	-	-	-	-	-	-	-	-	-	-	-
2289	-			-		-	-	-	-	-	-	-	-	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2376	-			-		-	-	-	-	-	-	-	-	-	-	-	1980	-	-	-	-	-	-	-	-	-	-	-	-
2554	-			-		-	-	-	-	-	-	-	-	-	-	-	-	-	2376	-	-	-	-	-	-	-	-	-	-
Pesticides/PCBs																													
Beta-BHC	-			-		-	-	-	-	-	-	-	-	-	-	30	35	-	-	-	-	-	-	-	-	-	-	-	-

Note: All concentrations expressed in micrograms per liter (µg/l), except for sediments which are expressed in micrograms per kilogram dry weight (µg/kg).

Tentatively identified compound based on scan number (non-priority pollutant) estimated concentrations.

J - an estimated value

TABLE 4-6. INORGANIC POLLUTANT CONCENTRATIONS IN SURFACE WATERS, SEDIMENTS, AND LEACHATES FOR DRY WEATHER SURVEY OF JULY 24, 1985

Inorganics	Reagent Blanks Water 1	Reagent Blanks Water 2	Reagent Blanks Water 3	Reagent Blanks Soils 1	Reagent Blanks Soils 2	Field Blank	Water Column Samples (SD) 1	2	3	4	5	6	7	8&9	10&11
Priority Pollutants															
Antimony	<60			<60		<31	<31	<31	<31	<31	<31	<31	<31	<31	<31
Arsenic	<10			<10		<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	<3.1	5.1J
Beryllium	<5			<5		<0.6	0.9J	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Cadmium	<5			<5		7.8	13	4.7J	9.2	3.2J	6.2	2.0J	<1.9	12	2.6J
Chromium	<10			<10		50	<50	60	<50	70	60	<50	<50	<50	<50
Copper	<25			<25		<4.5	16J	8.9J	12J	15J	13J	17J	6.9J	<4.5	11J
Lead	<5			<5		4.8J	12	11	9.8	4.5J	4.3J	7.8	17	11	42
Mercury	<0.2			<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2
Nickel	<40			<40		<20	<20	<20	60	70	70	60	<20	<20	70
Selenium	<5			<5		<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8
Silver	<10			<10		<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9
Thallium	<10			<10		<4.6	<4.6	<4.6	<4.6	<4.6	<4.6	<4.6	<4.6	<4.6	<4.6
Zinc	<20			<20		10J	36	21	22	38	13J	12J	25	18J	44
Cyanide	<5			<5		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenol	<5			<5		<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Other Parameters Measured															
Aluminum	<200			<200		309	877	769	926	293	360	347	596	34J	2020
Barium	<200			<200		7.1J	37J	37J	31J	20J	18J	18J	27J	25J	88J
Calcium	<5000			<5000		176J	38700	39100	39200	30100	28300	26200	37400	18400	32000
Cobalt	<50			<50		<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3
Iron	<100			<100		85J	1220	1060	1130	1160	881	720	880	312	4480
Magnesium	<5000			<5000		184J	14200	14400	14400	11300	10600	9810	13800	5910	13800
Manganese	<15			<15		3.8J	127	93	93	346	278	167	118	159	405
Potassium	<5000			<5000		1040J	6110	5710	5770	5510	5550	4850J	6590	3130J	9700
Sodium	<5000			<5000		532J	42400	35700	35500	35500	33300	28800	38500	15900	43400
Tin	<40			<40		<9.7	<9.7	<9.7	<9.7	<9.7	<9.7	<9.7	<9.7	<9.7	<9.7
Vanadium	<50			<50		23J	20J	19J	18J	18J	19J	19J	18J	<3.1	5.9J
Percent Solids (%)	-			-		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Inorganics	Sediment Samples (SD) 1	2	3	4	5	6	7	8&9	10&11	Leachate Samples (L) 10	20	3&4	5	P.E.
Priority Pollutants														
Antimony	<19	<30	<30	<19	<19	<19	<19	<18	<19	<31	<31	<31	<31	<31
Arsenic	13	19	14	6.8	12	6.0J	6.9	13	10	13	6.8J	15	6.3J	5.9J
Beryllium	<0.4	<0.6	<0.6	<0.4	<0.4	0.6J	0.4J	0.6J	0.6J	<0.6	<0.6	<0.6	<0.6	1.1J
Cadmium	11	7.6	12	3.9	2.0J	4.3	4.5	<1.1	<1.2	2.5J	2.6J	<9.4	5.1	11
Chromium	0.04	0.09	0.06	0.03	0.04	0.09	0.08	0.05	0.04	<50	80	<50	<50	3800
Copper	13J	28	71	24	38	13J	13J	52	10J	12J	5.9J	<4.5	4.8J	24J
Lead	31	9.9	70	15	13	10	8.2	12	45	28	11	8.7	11	6.8
Mercury	<0.1	<0.2	<0.2	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2
Nickel	<0.01	0.07	<0.01	0.06	0.05	0.09	0.06	0.06	0.06	50	50	80	100	800
Selenium	<2.9	<4.8	<4.6	<3.0	<2.9	<3.0	<3.0	<2.7	<2.9	<4.8	<4.8	<4.8	<4.8	<4.8
Silver	<2.4	<3.9	<3.7	<2.4	<2.3	<2.4	<2.4	<2.2	<2.4	<3.9	<3.9	<3.9	<3.9	<3.9
Thallium	<2.8	<4.6	<4.4	<2.8	<2.8	<2.8	<2.9	<2.6	<2.8	<4.6	<4.6	<4.6	<4.6	<4.6
Zinc	51	105	221	116	51	43	48	35	37	32	9.4J	20	18J	57
Cyanide	<1.5	<1.5	<2.4	<1.5	<1.5	<1.5	<1.6	<1.4	<1.5	<10	<10	<10	<10	<10
Phenol	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Other Parameters Measured														
Aluminum	4190	17200	13500	5670	4910	3880	8030	7780	3880	998	<25	175J	405	309
Barium	32J	145J	160J	41J	20J	21J	36J	30J	21J	80J	218	1020	415	15J
Calcium	195J	2270J	1940J	2450J	212J	<12	253J	<11	<12	34300	80400	69000	62400	60100
Cobalt	4.8J	11J	12J	8.6J	19J	4.9J	6.9J	6.2J	3.5J	<3.3	4.2J	<3.3	<3.3	27
Iron	7810	14800	21400	13200	15400	10400	11900	13600	9050	12200	18400	16600	5290	7850
Magnesium	1430J	3500J	3450J	3380	2430J	1680J	2370J	2570J	1610J	14600	34600	26400	19700	22500
Manganese	76	136	603	149	340	99	175	143	82	623	3780	371	220	201
Potassium	775J	1300J	998J	925J	904J	660J	928J	835J	776J	2430J	18000	19800	12100	20800
Sodium	389J	436J	213J	365J	598J	253J	611J	434J	235J	34800	12300	91700	81000	83900
Tin	<5.9	<9.6	<9.3	<6.0	<5.8	<6.0	<6.1	<5.5	<5.9	<9.7	<9.7	<9.7	<9.7	<9.7
Vanadium	22J	53	36J	27J	26J	21J	28J	25J	16J	5.3J	<3.1	10J	18J	50
Percent Solids (%)	82	50	52	81	83	81	80	88	82	NA	NA	NA	NA	NA

Note: All water concentrations expressed in micrograms per liter (ug/l), and sediment concentrations are expressed in milligrams per kilogram dry weight (mg/kg)

J - an estimated value

P.E. - wastewater plant effluent

Under tentatively identified compounds in the VOA and ABN fractions there were peaks identified as unknowns. Library searches were made to attempt to identify these compounds. The scans at which the peaks occurred are listed in the tables. U.S. Testing commented that the compounds are suspected to be hydrocarbons; however, were of the opinion that the compounds were laboratory contaminants rather than sample components. U.S. Testing commented that results from reanalyses of chromium and nickel by Atomic Adsorption coincided with those reported by the ICP analysis. The repeat data indicated lower results in both soils and water samples. The repeat data at higher concentrations correlated with the original data, however, recoveries were not within normal control limits. An analysis comparing a mass balance of these metals between plant effluent and river water analyses was extremely poor and did not agree with the good balance on TDS and chlorides previously discussed. It was concluded that the nickel and chromium data could not be used.

Discussion of Data Dry Weather Survey

Water Column Samples--

The organic priority pollutants, VOA, ABN, and pesticides concentrations detected in water samples were low, generally less than 10 μg/l. Tentatively identified volatile organic compounds in the water samples were few and at low <10 μg/l concentrations. Five tentatively identified ABN compounds identified as unknown, were measured in a number of the surface water samples at concentrations from 82 to 153 μg/l. The significance of these non-priority pollutants was considered minor given U.S. Testing's comments regarding their findings and opinions on laboratory contamination. The treatment effluent contained some of the trihalomethane compounds resulting from wastewater chlorination, including 27 ppb chloroform, 16 ppb bromodichloromethane, and 9 ppb dibromochloromethane.

Priority pollutant metals concentrations were generally less than 50 μg/l in all surface water and leachate samples, except for the previously discussed questionable results for chromium and nickel. Nickel ranged up to only 100 μg/l (leachate 5), and was 800 µg/l in the treatment plant effluent; and chromium was measured from <50 to only 80 µg/l (leachate 5) and was 1800 µg/l in the treatment plant effluent. Previous data in RAMP on treatment plant effluent showed low levels of chromium and nickel (i.e., <10 and <20, respectively). Cyanide and phenol were not found in concentrations greater than detection limits in any of the water column or leachate samples.

Surface water priority pollutant metals data collected were compared with parameters listed under the New Jersey Surface Water Quality Criteria for FW2-NT waters classifications of the Rockaway and Whippany Rivers, federal drinking water standards, and aquatic toxicity criteria listed in Table 4-7. Cadmium at 13 µg/l upstream of the site (SD1), exceeded federal drinking water and New Jersey FW2-NT standards of 10 µg/l; however, the sample blank analyzed high, 7.8 mg/l. Lead in water column samples exceeded the calculated aquatic toxicity criteria of 5.4 µg/l at 150 mg/l hardness for 4 day average once every 3 years; however, was less than the calculated value of 138 µg/l 1 hour once every 3 years. Lead was less than the drinking water and NJFW2-NT standards of 50 µg/l. All other parameters in the data show water samples upstream of the site, except for lead, had higher concentrations of detected priority pollutant metals than site downstream samples, indicating essentially no contribution by the site of these contaminants to the surface water.

The surface waters met all other criteria requirements for the FW2-NT classification, except for the low dissolved oxygen levels in the Rockaway River, both up and downstream of the site.

Sediment Samples—

Volatile organic concentrations in the sediment samples were low with the exception of the composited sediment sample from stations SD10 and 11, which were in the Rockaway River ponds adjacent to the north fill area. Fairly high concentrations of a number of these parameters were also detected in the sample

TABLE 4-7. WATER QUALITY AND AQUATIC TOXICITY STANDARDS

Pollutant	Federal Drinking Water Standards[b] (μg/l)	Proposed Allowable Limits Priority Toxic Pollutants[c]	4-Day Average[a] Concentrations (μg/l)	N.J.A.C.[d] 7:9 - 4.1
Antimony	-	145[c]	-	-
Arsenic	50	-	190	50
Beryllium	-	0.087[c]	-	-
Cadmium	10	-	1.6	10
Chromium	50	-	289	50
Copper	1000	-	26	-
Lead	50	-	5.4	50
Mercury	2	-	2.4	2
Nickel	-	133	-	-
Selenium	10	-	-	10
Silver	50	-	-	50
Thallium	-	4	-	-
Zinc	-	5000	-	-

[a]Water Quality Criteria Guidelines for Nine Pollutants, 50 FR 30784, July 29, 1985. For Average Hardness of 150 mg/l $CaCO_3$ Based on Ca and Mg Measurements. al - One Year Average

[b]EPA National Interim Primary Drinking Water Standards, 47 FR 10998, March 12, 1982 and Secondary Drinking Water Standards (July 19, 1981).

[c]Proposed Allowable Limits in Water, Priority Toxic Pollutants Health Impacts and Allowable Limits, Noyer Data Corporation, 1980.

[d]New Jersey Surface Water Quality Standards for FW2-NT Classification, NJAC 7:9 - 4.1 et seq.

and reagent blanks; however, not in other sediment samples. None of these components were detected in the water column at these sampling locations. These findings would tend to minimize the signifiance and any concern with respect to these contaminants in the sediments. A number of unknown acid base neutral compounds were also detected in sediment samples, at concentrations from several hundred, to over 20,000 μg/kg. These compounds were not found in the water column samples in high concentrations. Tentatively identified compounds identified as unknown concentrations, were quite high in both upstream and downstream sediment samples, as well as the ponds, thus, any contribution from the site was not clearly evident.

Various sediment samples (data Table 4-6 reported in mg/kg), contained zinc, lead, copper, cadmium (high field blank), and arsenic in concentrations greater than 5 mg/kg and up to 221 mg/kg zinc in the sediemnt sample at station SD3. This zinc level was higher than the 51 mg/kg concentration in the sediment upstream of the site at SD1, on the Whippany, and the 116 mg/kg zinc at SD4 upstream on the Rockaway. A pesticide, B-BHC, was detected at 30 and 35 μg/kg in sediments from SD1 and SD2 on the Whippany River. There are no criteria or standards for comparison of sediment contaminant concentrations, thus, it might be noted that the concentrations measured are considered relatively low and are not considered evidence of significant pollutant loads from the landfill site.

Conclusions--Dry Weather Survey

The dry weather survey results show that there was no significant organic or inorganic priorirty pollutant contamination in the surface waters, leachates or sediments. The surface waters upstream and downstream meet New Jersey standards for FW2-NT surface water except for dissolved oxygen in the Rockaway River.

The metals analyses for chromium and nickel were questionable even after repeat analysis by atomic adsorption. The QA/QC work was within NJDEP contract specifications which only requires that noncompliant analysis be flagged, not repeated. It should be noted that despite high spike recoveries for chromium and nickel in water samples, the concentrations measured downstream of the site by both ICAP and AA methods were less than the federal drinking water standards. Additional sampling and analysis may not appear entirely necessary, however, a confirmation set of samples would be appropriate, particularly of the treatment plant effluent.

There was no evidence that any significant pollution of the surface waters was occurring due to contamination from the landfill site or properties along the rivers between upstream and downstream sampling locations.

WET WEATHER SURVEY NOVEMBER 5, 1985

A wet weather surface water and leachate sampling survey was performed at the Sharkey Landfill site on November 5, 1985. Prior to the survey it had rained from approximately 6:00 p.m. on November 4th to approximately 7:00 a.m. on November 5th. Newark Airport data indicated 0.29 inches of rain fell on November 4th and 1.15 inches fell on November 5th.

River Flows

Flow measurements were made at SD3, Whippany River, and SD6, Rockaway River on the day of the survey. A current meter was used to measure the velocity at various points in the river cross-section. The cross-sectional area was measured and river flow was computed. Due to higher river depth and velocities during the wet weather survey, the velocity measurements were more difficult to obtain than during dry weather.

Measured Flow (cfs)

Whippany River @ SD3	183
Rockaway River @ SD6	112
Plant Effluent	18
Total (calculated @ SD7)	313

The U.S. Geological Survey (USGS) flow data from the gaging stations on the Rockaway, Whippany and Passaic Rivers were reviewed to determine the surface water flow variability prior to the survey and for comparison with the measured flows. A comparison of the gaging station flows during this period is as follows.

TABLE 4-8. USGS GAGING STATION FLOW DATA
(cfs)

Date (1985)	Rockaway River at Boonton	Whippany River at Morristown	Passaic River at Chatam
November 1	10	15	30
November 2	10	15	30
November 3	10	15	29
November 4	10	17	30
November 5[a]	12	132	257
November 6	10	81	270
November 7	10	32	199
November 8	10	23	143
November 9	10	20	118
November 10	10	19	99

[a]Day of survey

There was a significant increase in flow in the Whippany and Passaic Rivers on November 5 due to the rainfall. The Rockaway River flow did not increase significantly due to the reservoir upstream from which there was a controlled release of approximately 10 cfs, although the flow did increase slightly.

A comparison of the measured flows with gaging stations flows and flow per unit drainage area is as follows:

	Rockaway River	Whippany River	Passaic River
Upstream Gaging Station			
Drainage Area (sq. miles)	119	29.4	100
Flow (cfs)	12	132	257
cfs/sq. mile	0.1	4.5	2.6

	Rockaway River	Whippany River	Passaic River
<u>Measured Flows</u>			
Drainage Area (sq. miles)	136	69	-
Flow (cfs)	112 @ SD6	183 @ SD3	-
cfs/sq. mile	0.8	2.65	-
<u>Incremental Flow</u>(1)			
Drainage Area (sq. miles)	17	39.6	-
Flow (cfs)	100	51	-
cfs/sq. mile	5.9	1.3	-

(1)Difference between measured flow location and upstream gaging station

The Rockaway River had a low flow per unit drainage area of 0.1 cfs/sq. miles compared to the Whippany and Passaic Rivers due to the reservoir upstream. The measured flows of 112 cfs at SD6 for the Rockaway River and 183 cfs for the Whippany River at SD3 were higher than the upstream gaging stations. The Whippany River flow per unit drainage area of 2.65 cfs/sq. mile at SD3 was similar to the Passaic River flow at 2.6 cfs/sq. mile. The incremental flow increase per unit drainage area downstream of the gaging stations was higher for the Rockaway River at 5.9 cfs/sq. mile versus 1.3 cfs/sq. miles for the Whippany River. The lower runoff or flow/sq. mile in the Whippany can be partially attributed to the diversion of flow into the swamp area at Location L1o during this high flow period. The measured flows at SD6 and SD3 were 4.7 and 4.4 times, respectively, the measured dry weather survey flows.

A review of the 15 minute interval flows recorded at the Rockaway and Whippany River gages showed the following peak flows and times.

	Rockway River	Whippany River
Peak Flow @ Gaging Station, cfs	20	217
Time (November 5, 1985)	0530	0300

Since peak flows occurred at 0300 to 0530 at the gaging station, the samples collected at the Sharkey Site were collected after several hours of high flows. This satisfied the objective of the wet weather survey which was to collect samples during a significant wet weather event and if possible, to determine if there was migration of contaminants from the site to the surface waters or in the leachates during a sustained wet weather period.

Field Data Collection

Field measurements were made the day of the survey at all sampling locations for water temperature, dissolved oxygen concentration, pH, and specific conductance. In addition, samples were collected and analyzed for total dissolved solids (TDS), and chlorides at General Testing Corporation's laboratory in Hackensack, New Jersey. The field data, TDS and chlorides results are presented in Table 4-9. The river water temperature averaged 11.5^{o}C. Dissolved oxygen concentrations were 6.8 to 7.8 mg/l in the two rivers. The dissolved oxygen saturation value at 11.5^{o}C is 10.9 mg/l, therefore, there was a deficit of 3.1 to 4.2 mg/l in the surface waters, both upstream and downstream of the landfill site. The dissolved oxygen concentration was 2.4 mg/l in leachate L3. The pH in the river ranged from 6.1 to 6.65. Leachate pH ranged from 5.7 to 7.85. Specific conductance ranged from 280 to 390 μmhos/cm in the river samples, and 330 to 2600 μmhos/cm in the leachates with the highest value occurring in L6. The TDS concentrations ranged from 123 to 159 mg/l in the surface water samples and 101 to 1580 mg/l in the leachates with the highest concentration in L6. The chloride concentrations ranged from 27 to 41 mg/l in the surface waters and <5 to 420 mg/l in the leachates, again L6 had the highest value.

A TDS and chlorides mass balance was computed for the flow at the confluence of the Whippany and Rockaway Rivers. The treatment plant outfall (PE) discharged to the Rockaway River slightly upstream of the confluence. A mass balance similar to that done in the dry weather period, was computed to determine if the measured flows and computed TDS and chlorides loads at SD3, SD6 and PE agreed with the TDS and chlorides load at location SD7 downstream. The flow at SD7 was computed from the sum of SD3, SD6 and the plant effluent.

TABLE 4-9. WEATHER WEATHER SURVEY FIELD DATA SUMMARY
(November 5, 1985)

	Time	Temperature (°C)	Dissolved Oxygen (mg/l)	pH	Specific Conductance (μ mhos/cm)	TDS (mg/l)	Chlorides (mg/l)
Whippany River							
SD1	1040	11.0	6.75	6.4	390	159	41
SD3	1425	11.5	7.3	6.6	300	132	31
Rockaway River							
SD4	0908	11.5	7.7	6.1	280	123	27
SD6	1445	12.0	7.4	6.65	290	138	27
SD7	1430	11.5	7.8	6.5	325	133	33
Leachates							
L2o	1115	11.5	7.6	5.95	330	159	56
L3	1400	14.0	2.4	6.85	1170	554	80
L5	0755	11.9	8.9	5.7	127	65	<5
L6	1250	14.0	9.5	7.85	2600	1580	420
L8	1240	12.5	7.3	6.2	290	101	28
Plant Effluent	0940	19.0	8.4	6.9	990	539	88
Field Blank	0840	18.1	9.2	7.3	16	15	<5

	Flow (cfs)	TDS (mg/l)	TDS (lbs/day)	Chlorides (mg/l)	Chlorides (lbs/day)
SD3 (Whippany)	183	132	130,442	31	30,634
SD6 (Rockaway)	112	138	83,462	27	16,330
PE (Plant Effluent)	18	539	52,390	88	13,210
Total	313	158	266,294	36	60,174
SD7 (Rockaway)	313	133	224,797	33	55,777
Percent Difference			16		7

Similar mass balance calculations performed for calcium (4 percent), potassium (14 percent), sodium (21 percent), and magnesium (9 percent), also showed reasonable agreement indicating that the measured flows were reasonably balanced.

FIELD OBSERVATIONS

The following field observations and notes were made during the wet weather survey:

L1o - This leachate or drainage ditch which was sampled during the dry weather survey was not sampled since the flow direction had reversed and the Whippany River was flowing into the drainage ditch and swamp area.

L2o - Very low flow similar to dry weather (approximately 1 gpm). Water was fairly clean with no noticeable discoloration or odor.

L3 - L4 was not flowing as in dry weather survey. L3 had a very low flow (approximately 1 gpm). The water had some yellowish tint, with some foam and oil sheen on the surface.

L5 - The water in this drainage ditch was approximately 1.5 feet deeper than it was during the dry weather survey. There was a very low velocity and net flow to the river. The water was fairly clear.

L6 - The leachate appeared to be essentially surface runoff from the North Fill area to both sides of the bridge. The water looked clear with some yellowish color and no odor. There was a fragrant type chemical odor noticeable in the air at this location. Flow was estimated at about 2 gpm.

L8 - This leachate flow was significant and came from the marsh area on the other side of the North Fill which was dry during the July survey. There was also a pond in this area that was not observed in dry weather and which appeared to drain to location L8.

PE - The treatment plant effluent was very clear. The sample was collected after the chlorine contact tank. Plant flow averaged 11.7 mgd (18 cfs) on November 5th.

SD1 - Water was clear with little turbidity.

SD4 - Water was clear with little turbidity.

SD3 - The island between the two rivers at the confluence was flooded and not visible during the survey. The sewage plant outfall pipes were under water and not visible as they were in July 1985.

SD6 - Water was fairly clear with little turbidity.

SD7 - Water was fairly clear with little turbidity.

Analytical Results

The analytical results of the wet weather surface water survey samples and QA/QC information were presented in a report, "Sharkey Farms Landfill Samples of November 6, 1985," from U.S. Testing (Volumes 1 to 4 and Books 1 to 4 of the 19 books for the November sampling surveys). Data summaries were received prior to the report and results were reviewed on a preliminary basis. The final laboratory report was received on December 30, 1985. The organic and inorganic priority pollutant data are summarized in Tables 4-10 and 4-11, respectively. These tables compare the various priority pollutant concentrations detected in the samples with the method blank water used in the laboratory and the trip and field blanks. Only those organic compounds that had concentrations greater than detection limits are noted in the tables. Detection limits were presented in the laboratory reports.

A review of all U.S. Testing's reports (book numbers 1 to 19) for the November 1985 sampling surveys including groundwater and soils sampling surveys and QA/QC information was performed by Mr. Richard Scheible, the QA/QC Project Officer for this project. The QA/QC review and responses are presented at the end of this section. In summary, the U.S. Testing report packages were complete and satisfactory for all organics analyses. Data for arsenic, selenium, tin and lead, and those ICP results with non-linear dilutions which were flagged in the reports with an "E" were not acceptable. These included all aluminum, potassium and vanadium data. These flagged data were considered questionable, and therefore, were not used to evaluate the site. High concentrations of cyanide (108 ppb) and phenol (13 ppb) in the groundwater sampling field blank raised questions on the reliability of these data. These various concerns were discussed with U.S. Testing. Their comments and written response of January 23, 1986 are also included at the end of this section.

TABLE 4-10. ORGANIC CONCENTRATIONS IN SURFACE WATERS AND LEACHATES FOR WET WEATHER SURVEY OF NOVEMBER 5, 1985

Pollutant	Method Blank 1	Method Blank 2	Trip Blank	Field Blank	Surface Water SD1[(b)]	SD3	SD4	SD6	SD7	Leachates L2o	L4	L5	L6	L8	Plant Effluent
Volatile Organic Compounds															
Priority Pollutants															
Methylene Chloride	-	-	4J	-	1J	2J	1J	2J	2J	2J	2J	2J	-	2J	3J
Trichloroethene	-	-	-	-	-	3J			2J						
Tetrachloroethene			2J			3J					3J	2J		3J	3
Chloroform															21
Bromodichloromethane															12
Tentatively Identified Compounds															
Unknown VOAs 1130								10							
1131									10						
1139					10										
1149			6												
1150															6
1145														6	
1137							11			10					
1141				12											
1144												7			
1142						11									
1143													13		
1153											9				
Acid/Base/Neutral Organic Compounds															
Priority Pollutants															
Bis(2-ethylhexyl)phthalate	14	2			2JB	2JB	2JB		2JB	2JB	2JB		2JB	4JB	12JB
Benzo Pyrene	8		-		8JB	8JB	8JB		8JB		8JB		9JB		
Tentatively Identified Compounds															
Decamethylcyclopentasiloxane					50				16						
Unknown ABNs 191					42	17				10	12				
192				185											24
302										85					
314				8											
409						24									
410				15											
304												19			
926						12									
290													29		
1224													12		
1535													31		
312										8					
407										24					
213														160	
408					10										
198							45								
211									79						

Note: All water and leachate concentrations are expressed in micrograms per liter

(a) See Table4
(b) Notes sampling location number
(c) Notes sample number in 4888-A series

J = indicates an estimated value that is less than the specified detection limit, but greater than zero (e.g.i limit of detection is 10 ug/l and a concentration of 3 ug/l is calculated it is reported as 3J)

B = indicates that the analyte was found in the blank as well as sample.

TABLE 4-11. INORGANIC CONCENTRATIONS IN SURFACE WATERS AND LEACHATES FOR WET WEATHER SURVEY OF NOVEMBER 5, 1986

Pollutant	Matrix Blank 1	Matrix Blank 2	Field Blank	Surface Water SD1	Surface Water SD3	Surface Water SD4	Surface Water SD6	Surface Water SD7	Leachates L2o	Leachates L4	Leachates L5	Leachates L6	Leachates L8	Plant Effluent P.E.
Priority Pollutants														
Antimony	<60	<60	<43R	<43R	<43R	<43R	<43R	<43R	<43R	<43R	<43R	<43R	<43R	<43R
Arsenic	<10	<10	<7.6	<7.6	<7.6	<7.6	<7.6	<7.6	<7.6	<7.6	<7.6	<7.6	<7.6	<7.6
Beryllium	<5	<5	<0.9	<0.9	<0.9	[3.2]	<0.9	<0.9	<1.3	<0.9	<0.9	<1.0	<0.9	<0.9
Cadmium	<5	<5	<2.1	<2.1	13	[3.1]	<2.1	<2.1	<2.1	<2.1	<2.1	6.1	<2.1	<2.1
Chromium	<10	<10	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	<5.3	22
Copper	<25	<25	<6.2	34	[11]	<6.2	[17]	<6.2	<6.2	<6.2	<6.2	35	<6.2	<6.2
Lead	<5	<5	<4.7R	80ER	<4.7R	<4.7R	<24ER	<25ER	<4.7R	<4.7R	<4.7R	32ER	<4.7ER	<4.7R
Mercury	<0.2	<0.2	<0.1R	<0.1R	2.1R	<6.2R	<0.1R	<0.1R	<0.1R	<0.1R	<0.1R	<0.1R	<0.1R	<0.1R
Nickel	<40	<40	<15	<15	<15	<15	<15	<15	<15	<15	<15	46	<15	<15
Selenium	<5	<5	<4.8	<4.8	<4.8	<24	<4.8	<4.8	<4.8	<24	<4.8	<4.8	<25E	<25E
Silver	<10	<10	<3.0R	<3.0R	<3.0R	<3.0R	<3.0R	<3.0R	<3.0R	<3.0R	<3.0R	<3.0R	<3.0R	<3.0R
Thallium	<10	<10	<6.7R	<6.7R	<6.7R	<6.7R	<6.7R	<6.7R	<6.7R	<6.7R	<6.7R	<6.7R	<6.7R	<6.7R
Zinc	<20	<20	26R	105R	68R	70R	61R	43R	60R	62R	60R	73R	36R	54R
Other Parameters Measured														
Aluminum	<200	<200	209E	3820E	1830E	2430E	1870E	1530E	593E	372E	450E	1130E	2080E	1280E
Barium	<200	<200	<2.0	[86]	[32]	[46]	[44]	[27]	[37]	336	[33]	[162]	[21]	[14]
Calcium	<5000	<5000	[100]	23400	19400	22600	19600	20900	14100	89900	8360	130000	18400	59400
Cobalt	<50	<50	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9	<3.9
Iron	<100	<100	[88]	6810	2810	3440	2620	2430	984	7520	1040	1310	2690	698
Magnesium	<5000	<5000	[326]	9190	7140	8450	7350	7680	[4630]	29800	[2560]	44300	7110	24000
Manganese	<15	<15	<0.1	446	178	214	159	173	66	735	20	20	132	[9.9]
Potassium	<5000	<5000	[335]E	[4910]E	[3980]E	5570E	4790E	[4630]E	[4400]E	14700E	[2950]E	70500E	[4970]E	22200E
Sodium	<5000	<5000	[348]	23300	18100	21400	16800	19700	33600	60300	5280	329000	16400	79800
Tin	<40	<40	<11R	<55ER	[35]ER	<55ER	55ER	<55ER	<55ER	<55R	<55ER	<55ER	<55ER	<55ER
Vanadium	<50	<50	[5.3]E	[24]E	[20]E	[25]E	[18]E	[20]E	[19]E	[21]E	[23]R	[22]E	[25]E	[26]E
Cyanide	<10	<10	<10	<10	<10	14	10	33	<10	32	<10	332	<10	<10
Phenol	<5	<5	<5	13	5.5	<5	17	29	<5	16	13	50	63	<5

All water and leachate concentrations are expressed in micrograms per liter (ug/l)

E = indicates a value estimated or not reported due to the presence of interference.
R = indicates spike sample recovery is not within control limits
[ ] = indicates that concentration is less than contract detection limit, but greater than instrument detection limit.

U.S. Testing's comments on the inorganics data were basically, that the matrix effects and serial dilution interferences noted for furnace analyses were related to the samples and not to the laboratory instrumentation. This conclusion was based on their review of calibration verification, EPA QC samples, and reagent blanks which were within acceptable limits, and the absence of similar interferences with other project samples analyzed on the same day. U.S. Testing also indicated that the high phenol concentrations in one field blank was unlikely due to laboratory contamination since they contend that laboratory contamination would be corrected for in the blank sample which was subjected to the same sample preparation steps. U.S. Testing redistilled and reanalyzed the field blank and no cyanide was detected. Although the holding time had been exceeded, the sample had been preserved for cyanide, and therefore, should not have lost all cyanide, if cyanide in fact, was present. Since there is a question whether cyanide was initially present in this field blank, there is also a question as to whether cyanide was present in any of the other samples analyzed. The final comments on the project laboratory analyses are included in the QA/QC project officer's letter summary included at the end of this section.

<u>Discussion of Data</u>

There were no significant organic priority pollutant concentrations, or tentatively identified compounds detected in the surface waters and leachates. Several volatile and acid base-neutral compounds were detected at very low concentrations, generally less than 10 μg/l. The two acid base neutral (ABN) priority pollutant compounds, bis (2-ethylhexyl) phtalate and benzo (a) pyrene, detected in several samples at very low estimated concentrations, were also present at similar concentrations in the method blanks, indicating that the results probably are due to laboratory contaminants. One tentatively identified compound, decamethylcyclopentasiloxane, was detected at 50 μg/l at SD1 and 16 μg/l at SD7. It was not detected at SD3, downstream of SD1. This compound was considered a laboratory artifact since it is a form of the silanizing agents used to condition GC columns. This compound was not, therefore, considered as a sample component.

Several tentatively identified compounds identified by scan number and indicated as unknown volatile and acid base-neutral compounds were detected in samples at concentrations ranging from 6 to 185 μg/l. Those that were detected in the field blank were consisidered laboratory water contamination rather than sample contamination. Those detected in samples and not detected in the field blank were attributed to organic compounds which could not be identified. The unknowns were detected at less than 100 μg/l, except for one unknown compound in L8 sample at 160 μg/l. Rockaway River location, SD7, downstream of the site, had one unknown organic detected.

The surface water cyanide concentration of 33 μg/l at SD7 was considerably higher than the three upstream locations which contributed to the flow at SD7 (i.e., SD3, SD6 and PE). Samples from these locations were all at 10 or < 10 μg/l. This discrepancy, and the high cyanide concentration of 108 ppb initially detected in the groundwater sampling field blank, and upon reanalysis not detected, indicates that the cyanide data was inconclusive. Cyanide was also detected at SD4 and SD6 at concentrations of 14 and 10 μg/l, respectively, and in leachates L4 and L6 at 32 and 332 μg/l, respectively. Regardless of the data problems, the highest river water cyanide concentration measured was below drinking water standard of 200 μg/l, indicating that cyanide was not an environmental concern.

Phenol was detected in the surface waters at SD1, SD3, SD6 and SD7 at concentrations ranging from 5.5 to 29 μg/l, and in the leachates at L4, L5, L6 and L8 at concentrations ranging from 13 to 63 μg/l. These concentrations are low compared to the values of 2.5 to 3.5 mg/l for protection of aquatic life or protection of potable water supplies (N.J.A.C. 7:14A Appendix F). They do, however, indicate some potential discharge of contaminant from the site during wet weather and may be of some concern at the Passaic Valley Water Commission plant downstream.

The data indicate cadmium and mercury appear to be contributed to the surface waters (i.e., SD3 on the Whippany River) from the landfill site; however, in very low concentrations and this probably should be reconfirmed by additional sampling and analysis. Measured lead, iron and manganese concentrations were higher in the surface water upstream of the site indicating that these metals can not be attributed to the site. The river water quality at SD7, downstream of the site met drinking water standards for all priority pollutant parameters. Iron and manganese concentrations measured upstream on both the Whippany and Rockaway River were higher than at station SD7, thus these contaminants were not attributed to the landfill site.

Wet weather data for arsenic, selenium, tin and lead, aluminum potassium, and vanadium were unacceptable due to interferences in the analysis, as discussed in the QA/QC review. Values reported for these metals by U.S. Testing were quite low, with no obvious high levels of contaminants. It was concluded that these were probably of no concern. Resampling and confirmation of this would be appropriate, but not considered necessary to develop conclusions emerging from the bulk of the data that indicate no significant contamination of the surface waters as a direct result of the landfill site.

Based on both the dry weather and wet weather surface water, leachate, and sediment sampling surveys and data, the only present environmental concern relative to the surface waters may be the potential for phenols to cause taste and odor problems at the Passaic Valley Water Commission plant downstream in Little Falls. The phenol, however, would be considered only a minor concern, since there is considerable dilution of the Rockaway River which unites with the Passaic River before it reaches the Little Falls plant. At average river flows, the dilution factor is approximately 4.2 to 1. Activated carbon treatment is also used at the plant prior to chlorination.

Summary and Conclusions—Water Quality Sampling

There was no significant contamination of the surface waters at the Sharkey Landfill Site by organic or inorganic priority pollutants. Surface waters downstream of the site at SD7 met various water quality standards and aquatic toxicity criteria.

Tables 4-12, 4-13, and 4-14 were prepared to permit comparisons of upstream and downstream water quality parameters measured, in both the dry and wet weather surveys and sediment data from the dry weather survey. The organic data indicate very low concentrations of total organics, and essentially no obvious or significant (two sets of data) differences in upstream and downstream water column concentrations, except possibly for phenol and maybe cyanide results in the wet weather survey. These levels of contamination, however, would not be considered significant based on various water quality criteria and standards to which they may be compared.

Sediment samples taken during the dry weather survey contained relatively low levels of volatile organics. Estimated values of unknown volatile organics ranged from 13 to 192 µg/kg, and did not indicate significant pollution in the river sediments through the region of the site. The upstream sample on the Rockaway River contained a higher level of acid base neutral priority pollutants than the downstream samples at SD6 and SD7, both of which were zero. The Whippany River sediment, downstream of the site, contained 2040 µg/l ABN priority pollutants. Upstream sediment samples contained 31, 499 and 2661 µg/kg of unknown ABNs in the Rockaway and Whippany Rivers, respectively. Downstream levels in the Rockaway were 13,766 and 29,323 µg/l above and below the confluence with the Whippany River. Of the priority pollutant metals detected in the sediments, none, except possibly zinc and copper in the Whippany, increased to any significant extent from upstream to downstream samples.

The presence of the unknown ABNs in the sediments was not considered significant evidence of contamination of the surface watrs due to the site. The low levels of contaminants in the water column which did not include most of those unknown ABNs found in the sediment was considered more indicative of pollutant loads from the site. Various reasons for the levels of ABNs seen in the sediment might be proposed and could include transport from upstream locations either as sediment or in the water column, long term gradual transfer from the water to the sediments, or possibly due to a past spill or discharge to the streams.

TABLE 4-12. ORGANIC CONTAMINANTS DETECTED UPSTREAM AND DOWNSTREAM

	Rockaway River			Whippany River			Plant	Combined
	SD4	SD5	SD6	SD1	SD2	SD3	Effluent	SD7
				DRY WEATHER SURVEY				
VOAs								
Total Priority Pollutants	21J	6J	5J	0	3J	3JB	55J	7J
Other Identified VOAs	5J	15J	11J	12J	10B	6JB	0	13J
Unidentified VOAs	13J	7	6	10	9	6	0J	13J
ABNs								
Total Priority Pollutants	0	0	0	0	0	0	0	0
Other Identified VOAs	0	0	58	84	0	0	9	0
Unidentified VOAs	93	135	58	17	153	99	26	115
Phenols	<5	<5	<5	<5	<5	<5	<5	<5
Cyanides	<10	<10	<10	<10	<10	<10	<10	<10
				WET WEATHER SURVEY				
VOAs								
Total Priority Pollutants	1J	-	2J	1J	-	8J	39J	4J
Other Identified VOAs	0	-	0	0	-	0	0	0
Unidentified VOAs	11J	-	10	10	-	11	6	10
ABNs								
Total Priority Pollutants	10JB	-	0	2JB	-	10JB	12JB	10JB
Other Identified VOAs	0	-	0	50	-	0	0	16
Unidentified VOAs	45	-	0	52	-	53	24	79
Phenols	<5	-	17	13	-	5.5	<5	29
Cyanides	14	-	10	<10	-	<10	<10	33

J - Indicates an estimated value
B - Indicates analyte was found in blank as well as sample. Indicates possible/probable blank contamination.

Data in μg/l

TABLE 4-13. PRIORITY POLLUTANT METALS DETECTED IN SURFACE WATER UPSTREAM AND DOWNSTREAM OF SITE

	Rockaway River			Whippany River			Plant	Combined
	SD4	SD5	SD6	SD1	SD2	SD3	Effluent	SD7
				DRY WEATHER SURVEY				
Flow (cfs)	21	-	27	43	-	41	11.5	79.5
Cr*	70	60	<50	<50	60	<50	1800	<50
Ni*	70	70	60	<20	<20	60	800	<20
Zn	38	13J	12J	36	21	22	57	25
Cd	3.2J	6.2	2.0J	13	4.7J	9.2	11	<1.9
Cu	14J	13J	17J	16J	8.9J	12J	24J	6.9J
Pb	4.5J	4.3J	7.8	12	11	9.8	6.8	17
TDS (mg/l)	200	203	192	266	248	256	511	243
				WET WEATHER SURVEY				
Flow (cfs)	-	-	112	-	-	183	18	248
Cr	<5.3	-	<5.3	<5.3	-	<5.3	22	<5.3
Ni	<15	-	<15	<15	-	<15	<15	<15
Zn	70R	-	61R	105R	-	68R	54R	43R
Cd	3.1	-	<2.1	<2.1	-	13	<2.1	<2.1
Cu	<6.2	-	17a	34	-	11a	<5.2	<6.2
Pb	<4.7	-	<24ER	80ER	-	<4.7R	<4.7R	<25ER
TDS (mg/l)	123	-	138	159	-	132	539	133

a - Concentration less than contract detection limit, but greater than instrument detection limit.
J - Indicates an estimated value.
R - Spike sample was not within control limits--suspect data.
E - Estimated Value or not reported due to interferences.
* - Data not acceptable based on QA/QC reviews.

Data in µg/l, except as noted.

TABLE 4-14. PRIORITY POLLUTANTS DETECTED IN SEDIMENT SAMPLES IN SURFACE WATERS UPSTREAM AND DOWNSTREAM OF SITE DURING DRY WEATHER SURVEY

	Rockaway River			Whippany River			Combined
	SD4	SD5	SD6	SD1	SD2	SD3	SD7
ORGANICS							
Volatiles							
Priority Pollutants	8J	8JB	5JB	0	0	10JB	9J
Other Identified VOAs	74	15B	30B	0	23	31B	47
Unknown VOAs	29	13	53	145	192	12	128
Acid Base Neutrals							
Priority Pollutants	636	170	0	100J	-	2040J	0
Other Identified ABNs	0	0	0	0	0	0	0
Unknown ABNs	31499	22770	13766	2661	27808	31020	29323
Pesticides	0	0	0	0	0	0	0

Data in μg/kg

INORGANIC PRIORITY POLLUTANT METALS DETECTED	SD4	SD5	SD6	SD1	SD2	SD3	SD7
As	6.8	12	6.0	13	19	14	6.9
Cd	3.9	2J	4.3	11	7.6	12	4.5
Cr	.03	.04	.09	.04	.09	.06	.08
Cu	24	38	13J	13J	28	71	13J
Pb	15	13	10	33	9.9	70	8.2
Hg	0.4	<.1	<.1	<.1	<.2	<.2	<.1
Ni	.06	.05	.09	<.01	.07	<.01	.06
Se	<3	<2.9	<3	<2.9	<4.8	<4.6	<3
Zn	116	51	43	51	105	221	48

Data in mg/kg

B - Values for samples in which organic was found in blank included in total.
J - Estimated values included in total.

There were some analytical QA/QC problems with various metals analyses, and these were discussed in this section and in the QA reviews. In general, the acceptable data did not indicate any significant contribution to surface waters from the site. The data, considered unacceptable due to varius quality control limitations, did not indicate any significant or potential contaminant concentration concerns which warranted further sampling or investigations during the study. It may, however, be appropriate to resample for final confirmation purposes, if there is some concern on the part of New Jersey Department of Environmental Protection with respect to any potential environmental and/or public health impacts due to specific substances. Periodic long term monitoring of the site, which likely would be recommended to ensure that no new contamination problems arise from the site as time passes, should satisfy any lingering concern over the unacceptable data parameters measured.

ATTACHMENT A

CHAPTER 4

TOPOGRAPHIC MAP
LOCATION OF SURFACE WATER LEACHATE AND SEDIMENT SAMPLING POINTS

<u>EPA REGION II</u>
<u>SCANNING TRACKING SHEET</u>

DOC ID # <u>53761</u>

DOC TITLE/SUBJECT:

SHARKEY FARMS LANDFILL
NJ DEP – HAZARDOUS SITE MITIGATION ADMINISTRATION - SURFACE WATER / SEDIMENT AND LEACHATE SAMPLING LOCATIONS, AIR AND WELL LOCATIONS: MAY 1986 (EXHIBIT 4-1)

THIS DOCUMENT IS OVERSIZED AND CAN BE LOCATED IN THE ADMINISTRATIVE RECORD FILE AT THE

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290 BROADWAY, 18TH FLOOR
NEW YORK, NY 10007

6. PROPOSED RESPONSE

Based on the results of the field investigations (Chapters 2, 3, 4, 5), an analysis was made of the off-site and on-site environmental and health concerns. It included an evaluation of the extent of the contamination in the groundwater and surface water, and the impact on the surrounding environment and local residential areas. The identification and evaluation of site specific health and environmental concerns will serve as the basis to examine feasible remedial measures for the study area.

PUBLIC HEALTH AND ENVIRONMENTAL IMPACT

The results of the field investigation suggest that the Sharkey Landfill has a limited degree of contamination. This is based on the extensive sampling and analysis program carried out on the surface waters, groundwater, leachate, sediments, soils, and residential wells. The contamination can be considered at a very low level and is localized primarily at this time to the shallow aquifer on the Site. The evaluation of potential public health problems indicated the following:

- Existing residential, commercial and public wells are not located in the immediate area of Sharkey Landfill. Most residents in the immediate area are on public water supplies. Private wells in the area are located either upgradient in Montville or south of the site in East Hanover. It should be noted that the shallow aquifer at the Sharkey Site drains into the Whippany and Rockaway Rivers and probably has no impact on local private wells. The lower aquifer flow direction is generally in a westerly direction away from wells in East Hanover. There does not appear to be the likelihood of local residential wells to be exposed to contaminants from the Sharkey Site since the shallow aquifer is confined to the upper water table due to the extensive clay lens in the study area which separates the upper and lower aquifer.

- Any organic or inorganic compounds found in the sediments, soils, leachates, or surface waters should not be considered a public health risk since the concentrations found are extremely low, and, most importantly, these waters are not used in the immediate area for drinking purposes.

SHA 001 1159

° The only area where some contaminants were found in excess of drinking water standards was in the shallow aquifer under the North Fill, South Fill, and the Northwest Fill west of Route 280. Also, high levels of chromium and nickel were found in the lower aquifer. Additional sampling is recommended for the lower aquifer to confirm these results.

° Very low levels of contaminants were found in the shallow aquifer which drains into the Rockaway and Whippany River. Concentration of organics or heavy metals in excess of drinking water standards were not found immediately downstream of the site in the River at the confluence of the Rockaway or Whippany.

° Air contamination from volatile organics or methane should not be a problem and therefore should not be a potential health hazard based on existing data.

° The most likely public health problem would be dermal exposure at specific areas within the Sharkey Landfill. However, very limited contaminants were found in the soils, leachates, ponds and surface water samples and therefore potential health impacts should be considered low.

These data suggest that the public health risk associated with this site should be relatively low. This is the result of the low number of compounds detected at the Site, the low levels of contamination monitored in the different areas, and the fact that there is very limited human exposure at the Site. Only the Parsippany-Troy Hills Police Department use a portion of this Site on a regular basis. They have constructed a firing range along Sharkey Road west of the North Fill Bridge at the site where the security gate has been constructed as part of the immediate remedial action response plan for the Sharkey Landfill RI/FS.

The only potential for toxic impact on the surrounding environment would be in the Rockaway River, Whippany River, or local ponds from potential contamination of the Shallow aquifer. However, the priority pollutant concentrations measured in these water bodies are not considered high enough at this time to produce acute or toxic effects.

The public health risk associated with this site could change depending on future uses. These future activities could include excavation and construction of the site for commercial and residential use; the development of additional water supplies along Passaic or Rockaway Rivers or for new groundwater wells; and the potential for increased contaminant release into the Whippany and Rockaway Rivers from the shallow aquifer due to the proximity of the Rivers and the location of the landfill within the shallow aquifer.

It should be noted, however, that any major disturbance of the landfill for construction and/or removing the waste may result in increased exposure of workers and residents to potential hazardous consideration. Any planned development in the area must carefully consider a proper health and safety program to insure the safe well being of residents, workers, and the general public.

OBJECTIVES OF REMEDIAL ACTIONS

Since there appears to be presently very limited environmental or public health problems relative to the surface water, sediments, leachates, air and soil due to the low level of contamination monitored at the Site, the primary remedial objective would be to minimize the potential for migration of the low level of groundwater contamination monitored in the shallow aquifer to the surface waters which are used downstream for drinking water after water treatment. In addition to this primary objective, there are several other remedial objectives that should be considered in the analysis of appropriate remedial alternatives:

- Long term monitoring should be considered to evaluate surface water and groundwater characteristics on a regular basis.
- Additional site security should be considered to control public access to the Site.
- Erosion control for the banks of the Rockaway River must be included in the alternatives analysis to minimize the loss of refuse to the Rockaway River downstream of the Site.
- Also, additional monitoring should be considered for intermediate well, WI-17, to check out if the lower aquifer is

contaminated with benzene as indicated in the November 1985 survey.

- Also, monitoring of the Homestead public well in East Hanover should be considered to check out the cyanide level found in the November 1985 sampling.

- The monitoring of phenol at many surface water stations during the wet weather survey suggests that phenol monitoring be considered in future monitoring of the Rivers.

- Since there was some interference in the laboratory analysis of several metals (e.g., nickel, chromium, iron, manganese) during both survey periods, an additional sampling survey should be considered for all surface water, groundwater, leachate, soil and potable well sampling sites.

SHA 001 1162

ATTACHMENT B

CHAPTER 4

QUALITY ASSURANCE/QUALITY CONTROL
REVIEWS AND COMMENTS

general testing corporation

gtc

water and wastewater testing specialists

710 Exchange Street
Rochester, NY 14608
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(201) 488-5242

February 26, 1986

ACCE0020

Mr. Joseph Cleary
HydroQual, Inc.
1 Lethbridge Plaza
Mahwah, N.J. 07430

RE: Summary QA/QC Review
Sharky Landfill
P.O. # LS-034

Dear Mr. Cleary,

I've completed my review of all analysis reports for the Sharky Landfill Project. There were two main sampling events, July and November of 1985, Dry Weather and Wet Weather surveys, respectively. The monitoring wells were sampled in November '85, during the Wet Weather event. U.S. Testing were responsible for all analyses including Priority Pollutant + 40 using current EPA/CLP Protocols. NJDEP has adopted these protocols under its Tier I Reporting Requirements. My specific responsibility was to review all field and laboratory protocols and to review all laboratory reports from U.S. Testing.

The review for the report for the July analysis is covered under letters dated November 12, and November 16, 1985. Problems were found in both the organics and metals data. U.S. Testing responded in their follow-up report dated November 20, 1985. Our primary concern at this time was that spike recoveries were not within quality control limits, particulary for metals. At this time, U.S. Testing repeated Chrome and Nickel using AAS methods instead of ICP used in the original analysis. These AAS data confirmed the high possibility of false positive data using the ICP methods. U.S. Testing promised to review their ICP and furnace procedures in time for the November Wet Weather Survey.

The samples for the Wet Weather Survey and the monitoring wells were submitted to U.S. Testing in November '85 and their reports were submitted in December and January. My review fo the data is detailed in my letter dated January 14, 1985. No problems were found for the organics analysis. However, the results for the cyanide, phenols, and several metals were questionable. U.S. Testing responded to our questions in their letters dated January 23 , and January 30.

Regarding the cyanide data, U.S. Testing repeated analysis from the same sample volume used for the original analysis. Several results were significantly different,e.g. the field blank sample. This significant difference was attributed to either laboratory error on the initial results or loss of cyanide during sammple storage.

SHA 001 1164

The pH's reported for the stored samples were not sufficiently high to preserve cyanide for a period of two months. Only one sample had a pH of greater than 10. Given the sometimes dramatic difference in results in repeat analysis and the questionable field blank results in the initial set of data, I cannot approve this data.

Regarding the high phenol results, particularly in the field blanks, these results should not be used at trace levels below 100 ppb. U.S. Testing could not identify any specific problems in their analytical program. The possibility of phenol contamination in the field is slight, since only clean stainless. steel was used in the sampling.

Regarding the metals results from the November sampling, spike data was again not within quality control limits, particularly for the furnace results. None linear serial dilutions on several ICP metals were also found. U.S. Testing attributed these to matrix interference and flagged the data when results were outside quality control limits. I must approve these data since proper CLP protocol was used. However, caution should be used in applying results that have been flagged with bad quality control.

Regarding the sampling program, all field managers had approved beforehand the protocols to be used for obtaining both surface and monitoring well water samples. I spent two days, November 5th and 6th 1985, observing the field crews taking monitoring well samples. All protocols were properly followed, including calibration for all field meters. U.S. Testing provided bottles with preservatives and these were filled without rinsing. All samples were properly logged, including the Chain of Custody. Every attempt was made to keep all areas clean and to prevent any possibility of cross contamination.

I hope this letter is sufficient. If there are any further questions, please do not hesitate to call.

Very truly yours,

Richard Scheible
Vice President,
General Testing Corp.

cc: Alfred Crew Consultants
Dr. George Kehrberger

/le

SHA 001 1165

United States Testing Company, Inc.
Metals and Environmental Chemistry Division

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instrumental chemistry
trace analysis
analytical chemistry
methods development
chemical specialties
quality control
failure analysis

January 30, 1986

HydroQual Inc.
1 Lethbridge Plaza
Mahwah, N.J. 07430

Attn: Joe Cleary

ACE 0020

Dear Mr. Cleary:

We have reanalyzed all samples for which positive cyanide results were reported. The reanalysis results are as follows:

Sample		Original Result (ug/1)	Reanalysis Result (ug/l)	pH
4888-V	Field Blank	108	< 10	11
4886-II	(WS3)	243	< 10	6.2
4888-C	(L6)	332	216	8.5
4888-D	(SO4)	14	< 10	6.8
4888-F	(SO7)	33	< 10	7.7
4888-I	(L3)	32	< 10	7.6
4888-E	(WS 6)	15	< 10	[illegible].7
4888-Y	(PW 305)	23	< 10	7.7

Based on these results, we have concluded the following:

1. Because the pH of the Field Blank is still relatively high and no cyanide was detected in the reanalysis, the 108 ug/1 originally reported was incorrect.

2. Because the pH of sample 4888-C is still relatively high and the presence of cyanide at levels greater than 200 ppb was confirmed, the results originally reported were correct.

3. Because the pH of sample 4886-II has fallen significantly below the suggested preservation level of 12, no conclusion can be drawn from the reanalysis.

4. Because all other samples originally reported as positive had relatively low levels of cyanide and the pH in all cases has fallen significantly during storage, no conclusion can be drawn from the reanalysis.

SHA 001 1166

United States Testing Company, Inc.

We have reviewed all data in an attempt to identify the source of the apparently false positive result for the Field Blanks and we have been unable to attribute the error to a specific source. The high levels observed logically preclude the possibility of contaminated glassware. We can only assume that an error was made in spectrophotometric analysis of the final distillate.

If you have any questions, please do not hesitate to call me.

Very truly yours,

UNITED STATES TESTING CO., INC.

Maryann Gambino

Maryann Gambino
Manager
Metals & Environmental
Chemistry Division

MG/mdc

SHA 001 1167

United States Testing Company, Inc.
Metals and Environmental Chemistry Division

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January 23, 1986

Hydroqual
1 Lethbridge Plaza
Mahwah, New Jersey 07430

Attention: Joe Cleary

A00E0020

Dear Mr. Cleary:

In response to your inquiry concerning the inorganics data for the second submission of samples for the Sharkeys Landfill project, U.S. Testing Company (USTCO) would like to address the following points.

The usefulness of some of the metals data has been questioned by your QC reviewer. He has expressed concern regarding poor recoveries of digest spikes for some furnace metals (tin in particular). In addition, serial dilution of ICP digests did not indicate a linear response for some metals, most notably, aluminum. You will note that results reported for these samples are flagged with the letter "E". This flag indicates the existence of these problems to make the data user aware of the presence of non-specific interferences, as per CLP requirements.

CLP procedures are used by EPA as a first level evaluation and are designed to produce data of known quality. They allow for the existence of matrix effects, for which results are not corrected. They do not, however, allow matrix effects to go undetected or for results produced from samples exhibiting matrix effects to be reported without so indicating.

Review of the raw data from furnace analyses confirms the fact that the instruments were in control. Calibration verifications, EPA QC samples, and reagent blanks were within acceptable limits. The fact that matrix and digest sample recoveries were low is clearly indicative of a matrix effect associated with the samples. Re-analysis of several digests has confirmed this. Further evidence for the existence of matrix effects is provided by the fact that a non-linear response was observed for some ICP elements. Again, examination of the raw data indicated that the instrument was in control. A quarterly linearity check, last performed on 11/14/85, confirms the fact that the instrument produces linear responses. Further, serial dilutions of

SHA 001 1168

samples other than those submitted for this project, analyzed on the same day as your samples, exhibited a linear response for all elements. To document this, we have included copies of the raw data which were originally not submitted as they did not pertain to your samples.

Concern was also expressed over the fact that low levels of phenol were detected in some of the field blanks. The question was raised as to the possibility of low level laboratory contamination. This is unlikely because phenols are measured colorimetrically and the spectrophotometer is calibrated against a blank which is subjected to all sample preparation steps. Therefore, even if low level lab contamination were present, it would be corrected when the instrument zero was set using the distilled and extracted blank.

Finally, the question of possible cyanide contamination in a field blank was raised. We have redistilled and reanalyzed the sample in question and detected no cyanide. At this point, it is unknown whether this is due to the age of the sample or the absence of cyanide. We are in the process of redistilling and reanalyzing all samples in which cyanide was detected. Positive results for these samples will be presumptive evidence that the field blank result was incorrect. We will inform you of the results of these analyses as soon as they are available.

If you have any further questions, please do not hesitate to call me.

Very truly yours,

UNITED STATES TESTING CO., INC.

Maryann Gambino

Maryann Gambino
Manager
Metals & Environmental
Chemistry Division

Enclosures

MAG/mdc

ACT NAME : EPA TIME : 05-DEC-85 11:2

6230/7 S

	I.S.	AL	SB	BA	BE	CD	CA	CR	CO	CU
EXP# 1	1000	33.36	<.0000	.4868	.0023	.0076	<.0000	.0398	.0199	.0334
EXP# 2	1000	33.41	<.0000	.4863	.0017	.0062	<.0000	.0384	.0227	.0303
EXP# 3	1000	33.01	<.0000	.4812	.0023	.0039	<.0000	.0368	.0236	.0303
AVERAGE	1000	33.26	<.0000	.4848	.0021	.0059	<.0000	.0383	.0221	.0313

	H-FE	L-FE	PB	MG	MN	NI	AG	NA	V	ZN
EXP# 1	42.51	41.83	.0737	10.02	1.386	.0491	<.0000	.9377	.0536	.1524
EXP# 2	42.41	41.78	.0470	10.01	1.390	.0284	<.0000	.9070	.0539	.1532
EXP# 3	42.38	41.60	.0551	10.02	1.378	.0284	<.0000	.8851	.0539	.1537
AVERAGE	42.43	41.74	.0586	10.02	1.385	.0353	<.0000	.9099	.0538	.1530

	AS	SE	K
EXP# 1	.2219	.1122	2.264
EXP# 2	.1195	.2604	2.189
EXP# 3	.0875	.1384	2.204
AVERAGE	.1429	.1703	2.219

ACT NAME : EPA TIME : 05-DEC-85 11:26

6230/9S

	I.S.	AL	SB	BA	BE	CD	CA	CR	CO	CU
EXP# 1	1000	38.30	<.0000	.1349	.0010	.0051	<.0000	.0516	.0271	.0376
EXP# 2	1000	38.26	<.0000	.1329	.0017	.0041	<.0000	.0500	.0352	.0329
EXP# 3	1000	38.33	<.0000	.1327	.0003	.0037	<.0000	.0502	.0302	.0188
AVERAGE	1000	38.29	<.0000	.1335	.0010	.0043	<.0000	.0506	.0308	.0298

	H-FE	L-FE	PB	MG	MN	NI	AG	NA	V	ZN
EXP# 1	54.71	53.66	.0404	19.95	1.046	.0343	<.0000	.7404	.0555	.1989
EXP# 2	54.20	53.44	.0548	19.55	1.031	.0372	<.0000	.7664	.0527	.1918
EXP# 3	54.55	53.58	.0351	19.65	1.039	.0476	<.0000	.7517	.0556	.1940
AVERAGE	54.49	53.56	.0434	19.72	1.039	.0397	<.0000	.7529	.0546	.1949

	AS	SE	K
EXP# 1	.1986	.2688	4.888
EXP# 2	.1576	.1773	4.933
EXP# 3	.1678	.2994	4.873
AVERAGE	.1747	.2485	4.898

SHA 001 1170

ACT NAME : EPA TIME : 05-DEC-85 11:5?
85611-003-3

	H-FE	L-FE	PB	MG	MN	NI	AG	NA	V	ZN
EXP# 1	<5.000	2.822	.1250	7.183	.1800	.0079	<.0000	18.43	.0202	.0659
EXP# 2	<5.000	2.785	.1124	7.129	.1762	<.0000	<.0000	17.94	.0194	.0738
XP# 3	<5.000	2.811	.1077	7.109	.1762	.0020	<.0000	18.00	.0199	.0628
VERAGE	<5.000	2.806	.1150	7.141	.1775	.0025	<.0000	18.12	.0198	.0675

	AS	SE	K
XP# 1	.1582	.2568	4.078
EXP# 2	.1127	.2622	3.928
EXP# 3	.1547	.2621	3.928
VERAGE	.1419	.2604	3.978

CT NAME : EPA TIME : 05-DEC-85 12:00
6230/5 SER DIL 10X

	I.S.	AL	SB	BA	BE	CD	CA	CR	CO	CU
EXP# 1	1000	.0737	<.0000	<.0000	.0011	<.0000	.0600	<.0000	<.0000	<.0000
XP# 2	1000	.0748	<.0000	<.0000	<.0000	<.0000	.0618	.0002	<.0000	<.0000
EXP# 3	1000	.0697	<.0000	<.0000	.0011	<.0000	.0390	.0000	<.0000	<.0000
AVERAGE	1000	.0727	<.0000	<.0000	.0007	<.0000	.0526	<.0000	<.0000	<.0000

	H-FE	L-FE	PB	MG	MN	NI	AG	NA	V	ZN
EXP# 1	<5.000	<.0000	.0016	.0355	<.0000	.0005	<.0000	.0086	.0017	.0002
EXP# 2	<5.000	<.0000	<.0000	.0183	<.0000	.0034	<.0000	.0116	.0011	<.0000
XP# 3	<5.000	<.0000	.0172	.0251	<.0000	<.0000	<.0000	.0076	.0017	<.0000
AVERAGE	<5.000	<.0000	.0016	.0263	<.0000	<.0000	<.0000	.0093	.0015	<.0000

	AS	SE	K
EXP# 1	.0277	.0822	.1499
EXP# 2	.0721	.0873	.1050
EXP# 3	.0007	.0770	.1649
VERAGE	.0335	.0822	.1399

T NAME : EPA TIME : 05-DEC-85 12:04
?6230/9S SER DIL ~~5~~ 10X

	I.S.	AL	SB	BA	BE	CD	CA	CR	CO	CU
EXP# 1	1000	3.896	<.0000	.0126	.0011	<.0000	<.0000	.0042	<.0000	<.0000
EXP# 2	1000	3.920	<.0000	.0133	.0004	<.0000	<.0000	.0012	<.0000	<.0000
EXP# 3	1000	3.896	<.0000	.0123	.0004	<.0000	<.0000	<.0000	<.0000	<.0000
VERAGE	1000	3.904	<.0000	.0128	.0006	<.0000	<.0000	.0017	<.0000	<.0000

	H-FE	L-FE	PB	MG	MN	NI	AG	NA	V	ZN
EXP# 1	5.692	5.397	.0209	1.990	.1016	.0034	<.0000	.0418	.0067	.0174
EXP# 2	5.848	5.417	.0079	1.989	.1016	.0034	<.0000	.0664	.0098	.0185
EXP# 3	5.651	5.397	<.0000	1.967	.1016	<.0000	<.0000	.0489	.0064	.0172
AVERAGE	5.731	5.404	.0068	1.982	.1016	<.0000	<.0000	.0524	.0076	.0177

	AS	SE	K
EXP# 1	.0325	.0966	.5848
EXP# 2	.1109	.0511	.6447
EXP# 3	.0114	.1444	.6148
VERAGE	.0516	.0974	.6148

SHA 001 1171

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January 14, 1986

Mr. Joseph G. Cleary
HydroQual, Inc.
1 Lethbridge Plaza
Mahwah, New Jersey 07430

ACCE0020

Subject: QA/QC Review of U.S. Testing Reports for November 1985 Sampling at Sharkey Landfill

Dear Joe:

I have completed my review of the data package for the November 1985 sampling at Sharkey Landfill. The data, though complete, still leaves several questions:

1. There was no consistent unknown organic compounds reported (tentatively identified by scan number). Some attempt should be made to identify those unknowns with high concentrations, e.g., #4886-DD (sample location WS11).

2. U.S. Testing was careful to flag suspicious data. This was particularly important on the residence wells where the reported benzo-pyrene values were flagged as being due to laboratory contamination.

3. Tunes and matrix recoveries were generally within specifications with the exception of pesticides. Recoveries for DBC on pesticide extracts were generally low. However, no significant levels of pesticides were found in the samples.

4. We had several contamination problems with organics in field blanks during the dry weather survey. During this survey, all field blanks were satisfactory for organics. However, cyanide and phenols were found at unacceptably high levels for the field blank from the groundwater sampling survey. Cyanide was reported at 108 ug/l for field blank #4886-V. Phenols were found at the 10 to 15 ug/l range. I cannot trace the problem in the data reports. This problem should be considered, particularly for the high cyanide, in review and interpretation of these data.

5. Review of the metals data packages indicates several analysis problems.
   a. Data is questionable for all furnace analyses, with the exception of thallium. The final reported data cannot be traced in the raw data packages. Where the data is traceable, it conflicts, particularly in reported detection limits. All arsenic, selenium, tin and lead data are questionable.

SHA 001 1172

b. ICP data is questionable where serial dilution is non-linear. This is particularly true for most aluminum and several sodium, magnesium and iron results. Since these dilutions were non-linear and the data concentrations are reported in the instrument range, the data are questionable.

U.S. Testing has stated that where metals results are questionable, they have properly flagged the data. The EPA CLP protocol does not require repeat analysis. I find this response unsatisfactory given that these data cannot be used for the project.

In summary, the report packages are complete and satisfactory for all organics analyses. However, the metals data are not acceptable for arsenic, selenium, tin and lead, and those ICP results with non-linear dilutions. The high cyanide in the 4886-V field blank must also be considered in evaluating the data. We have discussed these problems with U.S. Testing and are awaiting their response.

Very truly yours,

GENERAL TESTING CORPORATION

Richard Scheible

Richard Scheible
Vice President kk

RS:kk

United States Testing Company, Inc.
Metals and Environmental Chemistry Division

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December 19, 1985

Alfred Crew Consulting Engineers/
Hazen & Sawyer
c/o HydroQual, Inc.
1 Lethbridge Plaza
Mahwah, NJ 07430

Attn: Mr. Joe Cleary

Re: Sharkey Farms Landfill

Mr. Cleary,

Enclosed please find the organic data package for the samples submitted to US Testing on November 6, 1985. The samples are identified in the Table of Contents and also on the General Testing chain of custody sheets.

The methodologies used were those in our contract with the USEPA under the Contract Laboratory Program. All the samples were analyzed as low level with dilutions as necessary to eleminate any interferences or above full scale response.

The report was too voluminous to bind in one package, so I have submitted it in volumes which are labelled on the front of each cover.

If you have any questions, please do not hesitate to call me.

Very truly yours,

UNITED STATES TESTING CO., INC.

Eliezer Patxot
Manager
Metals & Environmental
Chemistry Division

EP/mdc

SHA 001 1174

United States Testing Company, Inc.
Metals and Environmental Chemistry Division

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December 19, 1985

Alfred Crew Consulting Engineers/
Hazen & Sawyer
c/o HydroQual, Inc.
1 Lethbridge Plaza
Mahwah, NJ 07430

Attn: Mr. Joe Cleary

Re: Sharkey Farms Landfill

Mr. Cleary,

Enclosed please find the inorganic data package for the samples submitted to US Testing on November 6, 1985. The samples are identified in the Table of Contents and also on the General Testing chain of custody sheets.

The methodologies used were those in our contract with the USEPA under the Contract Laboratory Program.

Note that on the matrix spike analysis sample, Antimony, Lead, Mercury, Selenium, Silver, Thallium, Tin and Zinc were not within the contract specification recovery limits. The recoveries on these elements, except Selenium and Thallium, were slightly out of the desired windows, but the data can still be deemed technically valid. Selenium and Thallium had recoveries which indicate that there may have been some matrix interferences. As per contract requirements, this data was flagged with its indicative mark and no further action taken.

There are several elements whose values are flagged with an "E". Interpretation of this flag is as follows:

> As per contract requirements, one sample is designated to be analyzed at a 10X serial dilution. For any ICP element that does not fall within +/- 10% of the neat analysis all samples analyzed in that batch receive the "E" flag.
>
> Since all samples are spiked for their furnace elememnts, the "E" on furnace elements will appear on a sample by sample basis whenever any element does not meet the 40% recovery criteria.

SHA 001 1175

United States Testing Company, Inc.

Again as per contract requirements, no further action is taken on flagged data.

If you have any questions, please do not hesitate to contact me.

Very truly yours,

UNITED STATES TESTING CO., INC.

Eliezer Patxot
Manager
Metals & Environmental
Chemistry Division

EP/mdc

United States Testing Company, Inc.
Metals and Environmental Chemistry Division

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Decemeber 13, 1985

HydroQual, Inc.
1 Lethbridge Plaza
Mahwah, NJ 07430

Att: Mr. Joe Cleary

Re: Sharkey Farm Landfill

ACC E 0020

Mr. Cleary,

Enclosed please find the data summary package for the samples submitted to US Testing for the second round of samples of the above referenced case. This submission of data should supercede any which was previously sent to you, mainly because there are several samples whose values have now been flagged.

This case is still in the process of its final data review, therefore there are several points you should note when reviewing this data:

a. For the organic portion, only the HSL compounds have been submitted. The tentatively identified non-HSL compounds are determined upon the study of the spectra from the forward searches which are still being reviewed.

b. For the inorganic portion, all Selenium values should be disregarded at this time. Review of the QA/QC results dictated that Selenium be reanalyzed.

c. Also for the inorganic portion, for the soil samples submitted on 11-7-85 (Batch# 85-11-8), the Manganese duplicate and spike results warranted reanalysis of these samples.

All other data submitted is anticipated to be the values which should appear in the final report. If there are any changes, I will contact you as soon as possible.

As we have previously discussed, delivery of the final report and any outstanding data is still scheduled for the end of the week of 12/16. I will alert you of any delays ,if any, as soon as possible.

If you have any questions, please do not hesitate to contact me or Allan Tordini at 201-792-2400.

Sincerely

Eliezer Patxot
Manager

SHA 001 1177

1022

general testing corporation

gtc

water and wastewater testing specialists

710 Exchange Street
Rochester, NY 14608
(716) 454-3760

85 Trinity Place
Hackensack, NJ 07601
(201) 488-5242

November 26, 1985

ACCT. NO.

Mr. Joseph Cleary
HydroQual, Inc.
1 Lethbridge Plaza
Mahwah, New Jersey 07430

Subject: Sharkey Landfill: Repeat Analyses for Nickel and Chromium Dry Weather Survey, July 1985

Dear Mr. Cleary:

I have reviewed the AAS repeat analyses for chromium (Cr) and nickel (Ni) that we requested from U.S. Testing. The data is somewhat inconclusive.

1. Matrix recovery on soils is within range for both metals. Where ICP analyses originally reported high levels for both Cr and Ni, the repeat data by AAS indicates low or nondetectable concentrations.

2. Matrix recovery for Cr and Ni in the surface water samples were 400 and 200 percent, respectively. These are not within normal control limits. The sample AAS data correlates at higher concentrations with the original ICP data. At trace levels, <100 ug/l, there is no correlation, with a general trend of higher reported concentrations by AAS.

3. I could not determine any decent mass balances for the Cr or Ni. Since the treatment plant (PE) flow was approximately 1/7 the combined flows of the Whippany and Rockaway Rivers at location SD7, the river concentrations at SD7 should include 1/7 the concentration appearing at the PE site. In fact relative concentrations by AAS and ICP for Cr and Ni were 1600/50 and 850/<20, respectively, as [PE]/[SD7]. Relative data correlated well for other parameters, sodium, chlorides, TDS, etc.

Given this latest report, I feel we cannot use the metals data for any mass balance. U.S. Testing is researching their matrix recoveries, particularly for the waters. In the meantime, we cannot use any of the Ni or Cr results.

Very truly yours,

GENERAL TESTING CORPORATION

Richard Scheible

Richard Scheible
Vice President

RS:aec

SHA 001 1178

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November 20, 1985

Alfred Crew Consulting Engineers/
Hazen & Sawyer
c/o General Testing Corporation
85 Trinity Place
Hackensack, NJ 07601

Attn: Mr. Richard Scheible

Re: Sharkey Farms Landfill (USTC# 75495)

Mr. Scheible,

Enclosed please find Volume XI for the above referenced case. Its purpose is to address certain issues, from Volumes I-X, which need clarification or corrections.

1. In the organic portion of the report, there were several samples reported with compounds which were also found in the Reagent Blank analysis. These compounds should have been flagged with a B, which is the indication of this fact. The data reports for all the samples are included in this volume along with the corrected samples.

2. In the VOA and ABN fractions, there are peaks identified as unknowns. These peaks appear at approximately 195 scans in the ABN fraction and at approximately 935 and 1065 scans in the VOA fraction. We suspect that the ABN unknown (at 195 scans) is a product from aldo-condensation reactions which occur during the preparation of the extracts. At this time, we do not know exactly how many aldo-condensation product possibilities there are. Any peak reported as unknown has been searched against the most current NBS library for tentative identification. Unknown peaks appearing in the VOA analyses have also been searched against the NBS library, and although not tentatively identified they are suspected to be hydrocarbon compounds, indicated by the three closest matches from the library search. Note that the unknowns appear also in the Reagent Blank analyses, and it is our opinion that these compounds are laboratory contaminants rather than sample components. A possible source for this contamination may be hydocarbon impurities in the laboratory gases.

SHA 001 1179

3. In the inorganic analyses, values for Chromium and Nickel seemed suspect and therefore the digests were reanalyzed using Atomic Absorption Spectroscopic techniques. Note that samples were not redigested. The original analysis was performed as per USEPA Contract Laboratory Program requirements which recommends the use of Inductively Coupled Argon Plasma instrumentation. All QA/QC requirements for instrument calibration, blank detection limits, continuing and final calibrations were within contract specifications, but several samples did not comply with spike recovery criteria or linear serial dilutions. As per contract requirements, all noncompliant data was flagged and no further action taken.

Upon review of the Flame AA results it was noted that they did in fact coincide with those reported by ICP analyses. This sustains the validity of the original analysis by ICP. We are in the process of redigesting the spike sample to determine if in fact matrix effects are present or if the outliers were caused by the laboratory. Results of these tests will be available upon completion.

In this volume, pages 1-114 are the organic data report sheets with appropiate corrections. Pages 114-119 are the Flame Atomic AA results.

If you have any questions, please do not hesitate to call me at (201) 792-2400, ext. 325.

Very truly yours,

UNITED STATES TESTING CO., INC.

Eliezer Patxot
Manager
Metals & Environmental
Chemistry Division

EP/mdc

general testing corporation

water and wastewater testing specialists

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Rochester, NY 14608
(716) 454-3760

85 Trinity Place
Hackensack, NJ 07601
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RECEIVED
NOV 14 1985
HYDROQUAL, INC.
ACCT. NO. ACCE0020

November 12, 1985

HydroQual, Inc.
Mr. Joe Cleary
1 Lethbridge Plaza
Mahwah, NJ 07430

RE: Sharkey's Landfill
QC Review for July, 1985 Dry Weather Survey
P.O. # LS-034

Dear Joe,

I've reviewed the data from the dry weather sampling events at Sharkey's Landfill. The report is certainly voluminous. However, I found several problem areas. Specifically:

1) The field blank had identifiable and "unknown" organics. The identifiable compounds are traceable to laboratory contamination (see method blank values). The "unknown organics" however, must be traceable to the water provided for preparing the blanks. The compounds, identified by scan number, did not appear in any of the water samples which were collected in the same type of stainless steel containers, all prepared at the same time. US Testing has promised to analyze the field blank water before leaving the lab, for the next survey.

2) Several compounds identified in the library search program are laboratory artifacts, traceable to condensation reactions in the analysis system. These include:

4 - methyl - 2 - pentanone
4 - methyl - 3 - pentene - 2 - pentanone.

EPA protocols require these be reported when they are found. US Testing will flag these compounds on future reports.

3) Spike recoveries were acceptable for all compounds except di-n-butylphthalates and 4 - nitrophenol on the soils. No spike standards were recovered for these compounds.

Recoveries for pesticides were high on the soils. US Testing states these are attributable to dilution errors and are within reason.

4) Replicate analyses are all within Q.C. limits. All replicates were performed on spiked samples, as required by EPA protocols.

SHA 001 1181

5) Several "unknown" compounds were found, particularly in the soil samples. Most are at trace levels, and/or present in matrix blank analyses. Higher levels were found in the soil samples. NJDEP must evaluate this data for further action.

6) Where the same organics are found in both the reagent blanks and the samples, the sample reports must be flagged with a "b," meaning concentration reported for that compound may be attributable to laboratory contamination, particularly at trace levels. EPA protocols allow reporting trace levels, less than 20 ppb, of several volatile organics. For instance, methylene chloride can be reported as high as 25 ppb in laboratory blanks. This is simply a recognition of the difficulty of securing the laboratory atmosphere from the commonly used solvents.

7) Metals analyses were performed using a JA 7000 ICP system. The calibration runs were all within Q.C. limits. However, some data was questionable, particularly the chrome and nickel data. These values were unreasonably high in the river waters.

Upon evaluation of the raw data, we found that chrome and nickel instrument data was out of control in real samples. When digests were diluted, reported concentrations increased! The final report concentrations were obviously in doubt.

US Testing agreed that chrome and nickel values were questionable and that these analyses should be repeated using atomic absorption methods, at no additional charge.

In summary then, US Testing is revising their original report with an addendum responding to each of these issues, including new data for chrome and nickel for all samples. All Tordino has also stated that all metals analyses for the work currently in house will be performed using standard ICP methodology. Though he has agreed that AAS methodology is a more valid method for several metals, CLP protocols do not require it. He states that if AAS methods are requested there will be an additional charge. I suggest that myself, as Project Q.C. Officer, review all raw data before the final report is assembled.

I hope this memo is sufficient. If there are any further questions, please do not hesitate to call.

Very truly yours,

Richard Scheible,
Vice President

RS:sw

SHA 001 1182

United States Testing Company, Inc.
Metals and Environmental Chemistry Division

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instrumental chemistry
trace analysis
analytical chemistry
methods development
chemical specialties
quality control
failure analysis

October 17, 1985

Alfred Crew Consulting Engineers/
Hazen & Sawyer
c/o General Testing Corporation
85 Trinity Place
Hackensack, NJ

Att: Mr. Richard Scheible

Re: Sharkey Farms Landfill (USTC# 75495)

Mr. Scheible

Enclosed please find the inorganic data package for the samples submitted on July 25, 1985. The samples are identified in the Table of Contents and also on the General Testing chain of custody sheets.

The methodologies used were those in our current contract with the USEPA under the Contract Laboratory Program.

If you have any questions please do not hesitate to contact me or Allan Tordini at (201) 792-2400.

Sincerely,

UNITED STATES TESTING CO.

Eliezer Patxot
Manager
Metals & Environmental
Chemistry Division

SHA 001 1183

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Sincerely,

UNITED STATES TESTING CO.

Eliezer Patxot
Manager
Metals & Environmental
Chemistry Division

SHA 001 1184

5. SUMMARY OF FIELD INVESTIGATION RESULTS

This Chapter presents a summary of the results of the remedial investigation. Existing and potential Site problems are presented based on the data collected on surface waters, groundwater, soils, and air within the Sharkey Landfill Study Area.

SURFACE WATER INVESTIGATION

Chapter 4 of this Remedial Investigation Report presents a detailed discussion of the sampling program and laboratory results. The following discussion summarizes the results of the water quality surveys.

The results of the dry and wet weather surface water surveys performed in July 1985, and November 1985 respectively, indicated that there were no significant concentrations detected in the surface water or leachate samples for organic or inorganic priority pollutants. Surface waters downstream of the site met various water quality standards and aquatic toxicity criteria.

As shown in Table 5-1, cadmium and mercury were the only priority pollutants, which exceeded the drinking water standards downstream of the site at SD3 on the Whippany River (See Exhibit 4-1 in Chapter 4). This was observed only during wet weather.

TABLE 5-1. SURFACE WATER CONCENTRATIONS EXCEEDING CRITERIA (WET WEATHER SURVEY)

Chemical and Location	Drinking Water Standards (ppb)	4-Day Average Aquatic Toxicity Criteria (ppb)	Surface Water Concentration (ppb)
Cadmium SD3	10	1.6	13
Mercury SD3	2	2.4	2.1
Copper SD6	1000	26	17
Lead SD6	50	5.4	24 ER

SHA 001 1185

Cadmium was the only priority pollutant inorganics attributed to the site, which exceeded the aquatic toxicity criteria at SD3 on the Whippany River. Again, this occurred during the wet weather survey.

Lead was the only priority pollutant inorganic attributed to the site which exceeded the aquatic toxicity criteria at SD6 on the Rockaway River. This occurred both during the dry and wet weather surveys.

Non-priority pollutants, iron and manganese, also exceeded the drinking water standards at all the sampling locations, including upstream of the fill areas on both the Rockaway and Whippany Rivers. The cadmium, mercury, lead and copper concentrations at the locations noted (i.e., SD3 and SD6), were higher than those upstream of the landfill site, thereby indicating that there was a contribution to the surface water from the landfill site. The surface waters however met all applicable criteria at SD7, immediately downstream of the confluence of the Rockaway and Whippany Rivers.

It should also be noted that a number of "unknown" acid base neutral (ABN) compounds (organics) were also detected in sediment samples at concentrations from several hundred parts per billion (ppb) to over 20 ppm. These unknowns were found in high concentrations both in the upstream and downstream sediment samples, as well as in the ponds, and therefore any contribution from the Site was not clearly evident.

There are very limited criteria, guidelines or standards available on assessing sediment concentration of inorganics, organics or pesticides. ECRA guidelines for contaminated soil suggest that the heavy metals levels in the sediments are very low compared to the ECRA guidelines. There are no guidelines for "unknown" organic compounds found in sediments.

The four ponds located at the site, (SD8, SD9, SD10, SD11) and the six leachates sampled showed no contamination by organic or inorganic priority pollutants. With the exception of iron and manganese found in all leachates, and the nickel concentration in leachate L5, the leachate concentrations met drinking water standards. The data indicate that the leachates at the site have minimal concentrations of priority pollutants.

Phenol was detected in the surface waters at most locations only during the wet weather survey. The concentrations were very low compared to NJDEP effluent and groundwater criteria. The detection of phenol in the surface water needs to be confirmed in future monitoring programs. There is a potential for formation of chlorinated phenolic compounds during chlorination of the surface water at the Passaic Valley Water Commission Water Treatment Plant in Totowa, New Jersey. Phenol can cause taste and odor problems in the water supply at very low levels (i.e., 1 ppb). Discussions with the Passaic Valley Water Commission water treatment plant in Little Falls indicated that there is presently no phenol data or phenol analysis done on the raw water intake. Volatile organics analysis is conducted periodically. Granular activated carbon is used for taste and odor control and would adsorb phenol, if present.

Cyanide was not found in any concentrations greater than detection limits during the dry weather survey (July 1985). During the wet weather survey, the surface water cyanide concentration of 33 ug/l at SD7 was considerably higher than the three upstream locations which contributed to the flow at SD7 (i.e., SD3, SD6 and PE). Samples from these locations were all at 10 or less than 10 ug/l. This discrepancy, and the high cyanide concentration of 108 ppb initially detected in the groundwater sampling field blank, and upon reanalysis not detected, indicate that the cyanide data was inconclusive. Cyanide was also detected at SD4 and SD6 at concentrations of 14 to 10 ug/l, respectively, and in leachates L4 and L6 at 32 and 332 ug/l, respectively. Regardless of the data problems, the highest river water cyanide concentration measured was below the drinking water standard of 200 mg/l, indicating that cyanide was not an environmental concern.

There were some analytical QA/QC problems with various metals analyses, and these are discussed in Chapter 4. In general, the acceptable data did not indicate any significant contribution to surface waters from the site. The data, considered unacceptable due to various quality control limitations, did not indicate any significant or potential contaminant concentration concerns which warranted further sampling or investigations during the study. It may, however, be appropriate to resample for final confirmation purposes, if there is some concern on the part of the New Jersey Department of Environmental Protection with respect to any potential environmental and/or public health impacts due to specific substances. Periodic long term monitoring of the site, which would be recommended to ensure that no new contamination problems arise from the site as time passes, should satisfy any lingering concern over the unacceptable data parameters measured.

SUBSURFACE INVESTIGATION

Chapter 3 of this Remedial Investigation Report presents a detailed description of the subsurface investigation and the results of the field investigation. The following summarizes the results of the chemical monitoring of the ground wells, potable wells, and soil samples.

Groundwater Sampling

Twenty-six (26) monitoring wells were constructed at the Sharkey Site to investigate the hydrology, geology, and chemistry of the area and groundwater. Fourteen groundwater wells were constructed in the shallow aquifer, 10 wells in the lower aquifer as intermediate wells and two wells on the lower aquifer as deep wells. The shallow water table aquifer is separated from the lower aquifer by a silty clay unit. The clay unit is between 15 and 40 feet thick, possesses a low permeability, and appears to provide significant hydraulic isolation between the shallow aquifer and the lower unconsolidated aquifer.

Each of the 26 monitoring wells were sampled in November 1985 to characterize the chemistry beneath the site and in nearby wells. A detailed description of the subsurface investigation and results are presented in Chapter 3 of this Report. The following summarizes the existing and potential problems at the site based on the groundwater.

° Shallow Aquifer

The shallow aquifer drains primarily into the Rockaway and Whippany Rivers which are major tributaries to the Passaic River. The nearest downstream public use of the Passaic River is at Little Falls, where the Passaic Valley Water Commission (PVWC) has an intake at the Passaic River at that location. This plant serves approximately 259,000 people in the area and withdraws approximately 35,000,000 gallons per day (gpd). The PVWC has the capacity to supply water to other areas in the region and can reach a population of up to 600,000 people, according to the water commission. The present intake for this water supply is approximately eight miles downstream of the Rockaway/Passaic confluence.

Table 5-2 presents a summary of the organic compounds identified in the shallow monitoring wells. Total volatile organics and semi-volatile (ABN) compounds are presented for each shallow well. The concentrations shown in Table 5-2 are in micrograms per liter (ug/l) and represent relatively low levels of contamination. The specific volatile compounds monitored include chlorobenzene, trichloroethene, benzene, toluene, ethylbenzene, xylenes, and acetone, at very low concentrations.

Chapter 3 (Tables 3-2, 3-3) presents a tabulation of each compound identified at each well. The higher concentrations in the shallow aquifer were noted under the Northwest Fill (WS-5), South Fill

TABLE 5-2
SUMMARY OF IDENTIFIED ORGANIC COMPOUNDS (ug/l)
IN
SHALLOW MONITORING WELLS

	Monitoring Wells (WS)											
Organic Compounds	2	3	4	5	6	7	8	9	11	12	13	17
Total Volatile	7	0	0	51	95	0	0	58	115	40	41	4
Total Semi Volatile	0	0	2	172	8	0	0	112	154	161	12	2
Total	7	0	2	223	103	0	0	170	269	201	53	6

NOTE: Concentrations in ug/l.
Taken from Table 3-3 of Task 3 Report (Chapter 3)

(WS-6), and on the North Fill (WS-9, 11, 12). (See Figure 2.1-1 in Chapter 3 for the location of the monitoring wells.)

There were several tentatively identified (or unidentifiable) organics found in the shallow wells and are presented in Chapter 3 on Table 3-6. These tentatively identified compounds were identified by scan number and designated in Table 3-5 in Chapter 3. The highest concentrations were found in the wells on the North Fill (WS-9, WS-11, WS-13). However, much lower concentrations of these unknown organics were found in the surface waters (wet weather survey) with most unknown at levels less than 100 ug/l except for one leachate compound (160 ug/l). It should be noted that these unknowns (tentatively identified compounds) are not priority pollutants and that if NJDEP considers these levels to be significant, then guidelines have to be established by the State. At this time, the recommended additional monitoring will provide the additional data base to evaluate the significance of these unknown compounds.

It is apparent that there is a potential for contaminant transport from the North Fill to the Rockaway River. However, drinking water standards for the identified organic compounds were exceeded in only two of the monitoring wells, both on the North Fill, WS-12 and WS-13, for benzene, at very low levels, less than 25 ug/l. Surface water sampling conducted during the dry and wet weather surveys did not detect organic contamination in the Rockaway River either upstream or downstream of the North Fill.

On the basis of monitoring sites along the perimeter of the South Fill area (WS-2, WS-3 and WS-17), very low levels of total identifiable organic (volatile or semi-volatile) are present and discharged to the river (see Table 5-2). The highest organic levels on the South Fill were observed at Well WS-6, which is probably contributing groundwater to either well site WS-3 or WS-2. In terms of drinking water standards, concentrations measured in these two wells were below the standards for volatile organic compounds. WS-6, however, exceeds the standard for benzene (0.68

ug/l), with a concentration of 6 ug/l and the standard for trichloroethylene (3.1 ug/l) with a concentration of 13 ug/l. Neither of these organic compounds or any other organics monitored in these wells were detected in the Whippany River near these wells or downstream.

Monitoring the Northwest Fill (S), south of Route 280, at WS-5 indicated that it exceeded the standard for benzene with a concentration of 28 ug/l. None of the organic compounds monitored in WS-5 have been found in either the Whippany River surface water samples or leachate samples from the Northwest Fill area.

The Southwest Fill appears to be contributing very low levels of organics based on the results from monitoring well WS-4. Also, on the basis of surface water and leachate sampling, there does not appear to be an adverse affect on the Whippany River quality from the landfill.

In summary, although low levels of organic contamination have been detected in the fill areas in the shallow aquifer, the level of contamination does not appear to be resulting in adverse effects on the water quality of the adjacent Rockaway and Whippany Rivers. The low level of volatiles and semi-volatiles is localized in the shallow aquifer which drains into the Rockaway and Whippany Rivers. Furthermore, there are no known drinking water sources or private wells within the area immediately downgradient from the landfill. Therefore, the organic concentrations noted does not appear to pose an immediate off-site threat.

Inorganic chemicals, primarily heavy metals, especially iron, manganese, nickel and chromium are present within the shallow aquifer and surrounding areas. These data are presented in Tables 3-4 in Chapter 3. Iron and manganese appear to be common to the whole area including upstream groundwater monitoring stations (WS-1, WS-14) and upstream water quality stations. Chromium and nickel were found in many monitoring wells including the intermediate and deep wells. Although there was no indication during the

November sampling, there were interferences in the nickel and chromium analysis during the July 1985 dry weather water quality survey. Additional sampling should be considered for wells and surface waters. These metals do not appear to have any impact on water quality in the Rockaway or Whippany Rivers, as was discussed previously in the Section on Surface Water Investigation.

° Lower Aquifer

The results of the laboratory analysis of the 12 monitoring wells in the lower aquifer indicated that only one organic priority pollutant, benzene, was found in one well in the lower aquifer, Well WI-17. A concentration of benzene of 13 ug/l in this well does not meet recent NJDEP drinking water standard of 0.68 ug/l. However, this detection is an isolated occurrence and does not necessarily imply significant contamination of the lower aquifer. Since no other detections of this nature were made in the lower aquifer on site, assessment of this detection, in terms of environmental impact, should be withheld. The well should be resampled to confirm the presence of benzene at this location. If this presence is confirmed, additional hydrogeologic investigation in the vicinity should be performed to fully delineate the extent of contamination.

The analysis of the lower aquifer indicated, at selected monitoring wells, the presence of cadmium, lead, chromium, iron, lead, mercury, and nickel and concentrations in excess of drinking water standards. It should be noted that: iron and manganese was monitored throughout the Site in the shallow and lower aquifer and in the surface waters upstream of the site; cadmium was monitored at two wells (WD-2, WI-16); and lead at one well (WD-3). Nickel and chromium were monitored at several stations similar to the observations for the shallow wells. As noted for the shallow well, nickel and chromium measurements were in error during the dry weather water quality survey and, additional monitoring of the groundwater is recommended to confirm the past results. The other heavy metals appear to be at isolated well locations and additional sampling has been recommended to confirm the results.

The lower aquifer is used as a source of drinking water supply in the area by East Hanover. The East Hanover Township water supply system which is located essentially south of the Sharkey Site reportedly operates two wells in the Township and plans to put another in service within a year. The system serves a population of approximately 9,000. There are also a variety of domestic wells, presumably constructed in the lower aquifer throughout the East Hanover community section of the landfill. On the basis of sampling data, however, there is no evidence that the landfill is adversely affecting drinking water quality in the area.

Residential Wells' Sampling

Groundwater from six residential and commercial wells, and one public supply well was sampled and analyzed for chemical parameters. Most of the residents and commercial establishments in the immediate area (1 mile radius) are on public water supplies.

Three of the wells sampled are upgradient of the site in Montville, and a residential well on New Road has not been used for years. Two residential wells and the public water supply (Homestead Avenue Well) are located in East Hanover, southwest of The Sharkey Landfill site which is probably upgradient of the groundwater flow in the lower aquifer.

A detailed summary of the potable well investigation is presented in Chapter 3 of this Report. The following is a summary of the results:

* None of the potable wells samples appeared to be adversely affected in terms of organic contamination. Reported organic compounds (bisphthalate, benzopyrene, and carbon disulfide) were found in the field blanks and are probably laboratory induced.

° Inorganic analysis for metals indicated drinking water standards for iron were exceeded at three locations and manganese at one location. Iron and manganese appear to be common to the area as these substances were found in many surface and groundwater samples. It should be noted that none of these wells are reportedly used for drinking water supply at the present time. Also, two of these samples are upgradient of the Sharkey Site confirming the conclusion reached about iron and manganese being found throughout the Site in surface and groundwater samples. Other metals were found in the wells but were considered common parameters calcium, magnesium, potassium, sodium); less than standards; or inconclusive due to laboratory interferences.

° Cyanide was found only in the sample taken from the Homestead Avenue public supply well. The concentration of cyanide detected (23 ug/l) does not exceed the NJDEP groundwater standard of 200 ug/l. It should be noted, however, that cyanide was also found in the field blank associated with monitoring well sampling. The validity of this detection is therefore questionable. Additional sampling has been recommended for this well.

° Phenol was also found in the Homestead public well well at a concentration (83 ug/l) below the 3500 ug/l drinking water standard. Additional sampling will confirm this analysis.

° Chromium was found at a concentration of 46 ug/l in the Homestead Avenue public well. This concentration is close to the Federal drinking water standard of 50 ug/l. Additional monitoring is required to check out this concentration.

° Based on the recent sampling program, the limited number of existing residential wells in the immediate vicinity of the Sharkey Farms Site, and analysis of the hydrology of the lower aquifer (flow direction in a southwesterly direction), it appears that there is no evidence that the landfill is adversely affecting drinking water quality in the area.

Soils Sampling

Five locations were selected (see Exhibit 4-1) within the landfill study area to obtain shallow soil samples for chemical analysis. The sampling stations were located in two leachate seep drainageways, two storm water drainageways (Site S-3 and S-4), and an area of unexplained anomalous electromagnetic readings (Site S6). The sampling program results are presented in the remedial investigation report and are summarized as follows:

- Five volatile organic compounds were identified; methylene chloride, acetone, tetrachlorethene, 2-butanone and carbon disulfide. Methylene chloride and tetrachlorethene (PCE) were also found in the soil sampling field blanks. Carbon disulfide was also reported in two trip blanks. The compounds detected in field or trip blanks are questionable and should not be considered as site derived unless further qualification or proof of sample report validity is provided. Therefore, acetone, and 2-butanone were the only ones associated with the samples. Also, napthalene, phenanthrene, 2-methylnaphthalene, fluoranthene and possibly pyrene were detected in the soil samples.

- Four pesticides were identified in soil samples. Three of the four compounds were found at Site S5. These include dieldrin, 4,4'-DDD, and endrin ketone at concentrations ranging between 330 and 410 ug/kg. The PCB Aroclor-1254 was found at Sites S3 and S4 at 130 and 380 ug/kg, respectively.

- Several inorganic chemical compounds were detected in the soil samples from the five sites. In general, these detections were not unexpected, considering the inorganic matrix that the soils are composed of, nor were there indications of major anomalies between the sample sites and respective compounds. There are limited standards or guidelines available on metal concentrations in soils. Using the NJDEP and ECRA guidelines for metals in soils, the analysis suggests, for the metals defined, very low levels of contamination.

The levels of organic compounds found in the soils appear to be relatively low, and at least half of the compounds reported have been found in the field and trip blank analyses. The remaining compounds are in relatively low levels and do not suggest that problem contamination source areas are present at the near surface at the sampling locations. It is noteworthy that acetone and naphthalene were also found in the groundwater. Although several pesticides were identified in three (3) sod samples, none were found in groundwater samples.

AIR INVESTIGATION

Chapter 2 of this report presents the results of the air investigation. Limited air monitoring has been reported. The only sources of air quality data were the RAMP (1983), DEP monitoring of August 22, 1983, a 24 hour air monitoring investigation during the initial site visit for the RI Study (September 1984), and monitoring taken by field crews during the construction of the monitoring wells. During the well drilling operations through the fill areas, level C safety precautions were enforced at all sites. Organic vapor levels were monitored at several sites through the landfill using a NHU. Also, an explosimeter, oxygen meter, and radiation detector were used by the REWAI field crews throughout the field investigations.

The results indicated that the air quality measurements, including the 24 hour study in 1984, suggest low probability of respiratory or dermal hazards from air-borne volatile organics under ambient conditions.

SHA 001 1197